GE & GE ENG

December 2013 Volume 24

World Ranking:
US News and World Report ranks our Department 25th for Earth Science graduate schools. We are the highest ranked department at CSM.

GREETINGS FROM BERTHOUD HALL!

As you work your way into the next year, the Department is happy to offer you this snapshot of our activities in 2013.

No doubt you will hear some familiar themes and have memories sparked by these pages – who we are and what we do was shaped by every one of you in some way, and we are grateful for your connections to the Department over the years. It has been a fantastic year, with many areas of strength, productivity and growth. There is a tangible excitement around Berthoud Hall, as we have been in the process of breaking through to the next level as a Department. Our students, faculty, resources, and opportunities are excellent, and the pieces are falling into place for some subtle, yet stirring advances.

One galvanizing factor for us has been the adoption of a strategic plan for the Department. Initiated in 2012, we are working towards the vision "To be the top applied geoscience and geological engineering department in the U.S." While we will make every effort to align our plan with the new university-level strategic plan, this one was written for us, and has a number of goals that we are passionate about. We intend to enhance our resources and our student placement, improve our visibility and publicity, strategically expand our staff and equipment assets, and advance our rankings – both as a geoscience Department and for each of our specialty areas.

Speaking of rankings, we are once again ranked as the 25th best earth science graduate program by US News and World Report. As you may be aware, this ranking comes in spite of the uneven playing field: the methodology favors Departments whose focus is on basic research and large PhD populations, but we are a

Murray Hitzman
In the field with his energetic field assistant. It's good to have a lookout.

Department with much of our strength in applied research and a balance between MS and PhD. Nevertheless, we have a solid status established through years of producing outstanding graduates like many of you! We continue to have an outstanding reputation, attracting over 270 applications for graduate school last year. We have almost $6M in funded research, with world-class teams in multiple focus areas within geoscience. Our support comes from a range of federal agencies, industry consortia, and individual companies, giving us a very balanced portfolio that is the envy of other Departments.

Demand for geologists and geological engineers continues to be very high. We have over 150 majors in our sophomore, junior, and senior classes, and we have almost 200 graduate students, including a record group of 50 outstanding PhD students (who have the highest undergraduate GPAs of any doctoral program on campus). This represents the largest graduate program at CSM, and a powerhouse that can compare with the very top geoscience programs nationwide. Furthermore, employers love our students: almost 90% of our BS graduates have jobs or graduate school lined up within a short period after graduation, and that number increases to over 95% for our MS and PhD graduates.

Our Department staff is a solid pillar of support. At the end of 2013, we have 17 academic faculty, 2 teaching faculty, 10 active research faculty, 3 research associates, and 6 support staff. Marilyn Schwinger, our long-time administrative assistant and 40+ year CSM employee, retired at the end of June (although we brought her back for part of the fall!). It was a bittersweet transition, and we are grateful for the positive ways she helped shape our Department. Our faculty are truly exceptional – here are but a few examples of their roles and awards. Wendy Harrison continued her prestigious position as Director for the Division of Earth Sciences at the National Science Foundation. Steve Sonnenberg received the Michel Halbouty Award from AAPG. Maeve Boland wrote two fact sheets that received Shoemaker Awards from the USGS. Jerry Boak is the president of the Energy Minerals Division of AAPG. Murray Hitzman was interviewed by the BBC on critical minerals, and Reed Maxwell was interviewed by NBC Learn for Water Sustainability.

The Department is excited about two new faculty positions we are looking to fill this spring. The search is currently underway for the first Robert J. Weimer Distinguished Chair in Sedimentary and Petroleum Geology. This position will add a powerful new resource to our world-class petroleum geology group, and we made that statement in spades by launching the search with a symposium in his honor (see article later in the Newsletter). Thanks to so many of you for contributing to the development of this endowed chair position. We are also searching for a new lithogeochemist to add a solid rock chemistry capability to our economic geology group. We are fortunate to be able to expand our strengths and look forward to bringing new people on board.

Berthoud Hall is also seeing some changes. The thin section lab was remodeled last summer, adding mineral processing capabilities and improving the workflow layout. The never-ending process of clearing out and revitalizing labs and classrooms is changing the look of the building, and we are developing graduate student workspace areas to ease the demand for office space (an eternal problem that many of you will remember from your days here).

Thanks in large part to the support of our alumni and our industry partners, the Department is on sound financial footing. Your donations have allowed us to continue to provide a fantastic education to our students, offering frequent field trips, access to cutting edge equipment and computing resources, and life-changing research opportunities. Furthermore, these funds have allowed us to make large strategic efforts to launch the Department forward. Many geoscience Departments are struggling simply to survive: you have given us the ability to thrive. We extend our gratitude for your faith in what we are doing!

As you may have noticed, I am a new face in the role as Department Head, having taken over as Interim in June and assigned as Head officially in January. John Humphrey served admirably for 7 years as our Head, and he leaves a proud legacy of a Department on sound financial footing, with bursting enrollments at all levels. Please join me in thanking him for his tireless, unselfish, and skillful leadership.

The Department is strong and healthy, and this issue will tell you about many of the exciting developments underway. I offer my best wishes to you and your families for a safe, healthy, and prosperous New Year. I hope that you will continue your ties with the Department, by dropping us a line telling what you are up to, by visiting us when you can, and by getting in touch with old friends from your glory days at CSM! We wish you all the best from the Department of Geology and Geological Engineering.

Paul M. Santi
Department Head

Educational Outreach at Mines

By Christian Shorey

Mines is a school known for its technological prowess, and our students are the best evidence of our excellence, but more and more potential students view our publicly available on-line offerings as principal evidence of our technological standing. Therefore, besides continuing to run our 101 course and planning a new Paleoclimate course for next Spring, Dr. Shorey has been busy making new content for the Colorado School of Mines iTunesU site.

All this content is publicly available, and only requires the download of the free iTunes software. In the iTunes program, go to the iTunes store, and then search “Colorado School of Mines” to find our offerings. We have several new home based and guest lectures under “Campus Lectures”, including the lecture by Ron Blakey on the paleogeography and tectonics of Western North America, and a fascinating look into corporate social responsibility with Jessica Ralston and Murray Hitzman.

Under “Earth Explorations”, Dr. Shorey is adding content that complements our GEGN 101 Earth and Environment course. Highlights there are a series on using free software to construct basic climate models, an update on the recent flooding in Lyons, CO., and instructions for some of the 101 labs.

Possibly of greatest interest to our alumni is the new section titled “The Bob Weimer Geology Trail with Bob Weimer”. These

ACTIVITIES

Photo Captions:

Top: Bob Weimer, Joe Tempel at retirement reception for State Geologist Vince Matthews. Middle: John Bristow briefing aids prior to biggest tour group ever. Bottom: Aides Brianna and Jenna greeting guests at Annual Open House. Right: Brianna Svoboda, Charlotte Adams, Jenna Lente at the Denver Museum of Nature and Science in December.

programs have been made with both regular sound versions and closed captioned versions. Either way, you get the ever dynamic and insightful Bob Weimer giving us invaluable insights into the geology and history on our venerable campus.

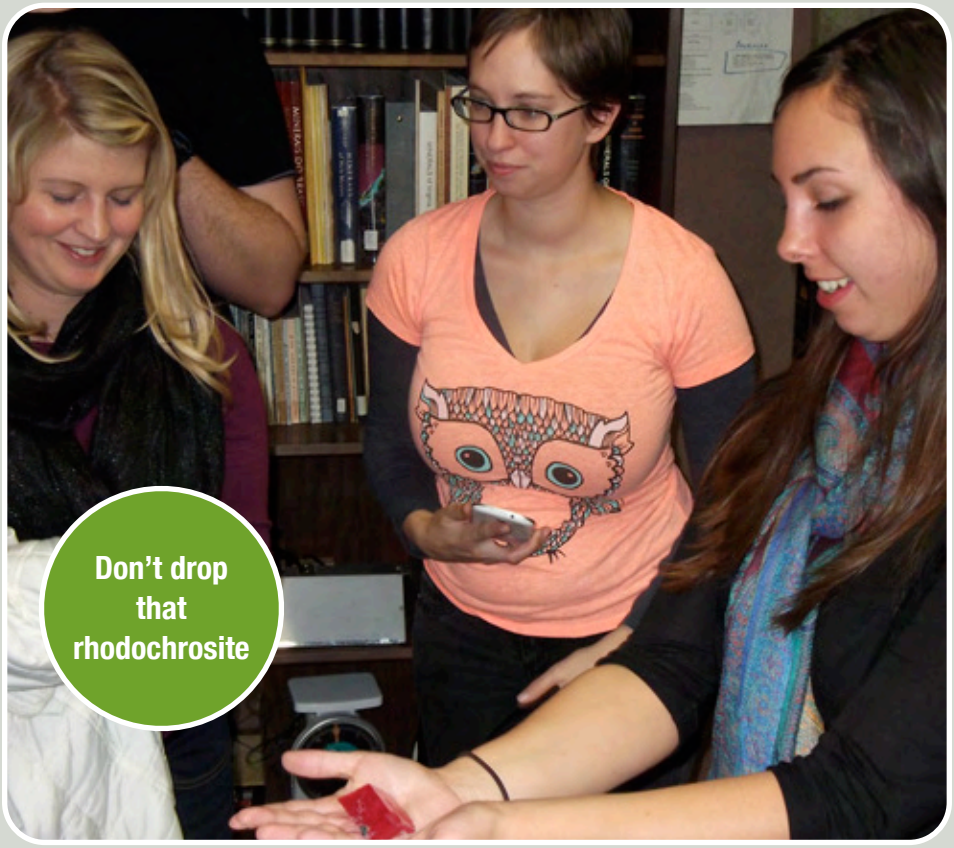
Dr. Shorey plans to continue contributing more public material to the iTunesU site, so if you're interested in keeping up with Mines in the 21st century, pay the site a visit, and then come by occasionally to see what's new.

Geology Museum Musings

By Bruce Geller, Director

Life in our Geology Museum continues in the fast lane. My sixth year at the helm of the Museum has seen more guests and gifts. I'm proud to announce that as of this writing, we were ranked by Tripadvisor.com as the #1 tourist attraction in Golden, in terms of visitor satisfaction, out of 26 Golden attractions, and were again awarded their Certificate of Excellence. This resulted from the help of our Advisory Council, Student Aides, staff, Friends of the CSM Geology Museum (FCSMGM), donors, volunteers, specimen loaners, visitors, visiting researchers, CSM faculty, administrators, and students who support us in so many ways.

The Advisory Council has met monthly and has discussed many topics, one of which is publishing a book about our Museum. On-going projects involve cataloguing new specimens, improving our database, and researching new advances in LED lighting. Our Advisory Council has played a key role in planning the logistics of several major construction projects. First, we moved our two safes from the Arthur Lakes Library into our main Museum gallery in August. Second, we have held serious discussions about remodeling our Gift Shop. Third, we are now engaged in discussions with contractors to rehang our elegant Irwin Hoffman mining murals this spring. The Advisory Council has budgeted for a complete conversion of our large format (free standing halogen) displays to LED illumination. We also discussed how to welcome special needs visitors, developed criteria for what sorts of donations we will accept, and how to respond to guests who wish to trade specimens.



I held weekly meetings with our Collections Managers and volunteers. These folks ran our Book/Garage Sales and have been busy keeping our Gift Shop well stocked. Our 2013 Gift Shop sales were down 21% but our donations box was up 9%. Our volunteer ranks have now risen to 63. Our facebook fans are up 74% over last year. Check out our facebook page at: http://www.facebook.com/pages/Colorado-School-of-Mines-Geology-Museum/168875179736, and you can follow the link to hundreds of lovely photos of our specimens, put on the web by Ron Wolf (GE '69).

I have met monthly with our Student Aides, who have led a vast majority of our tours this year (including our largest ever – 180 students in two hours in July), rented our teaching and fossil kits, helped with our Book/Garage Sales, and rung up all of our Gift Shop sales. One of our Student Aides, Brianna Svoboda, compiled our attendance data from 2012, which were really impressive. For example, we had over 22,200 guests for 2012, which is up 8% over 2011. Guests came from 113 Colorado towns, 40 foreign countries, and six continents. Interestingly, over 85% of our guests were first-time visitors.

Three Student Aides graduated in May 2013 (including Lauren McIver from GE), and another two in December (Matt Cornellisson and Jenna Lente from GE). For the spring term, we have hired a record 14 Aides, comprising the following students: one Ph.D. candidate, one M.S. candidate, 10 geology students, 3 mining engineers, 1 biochemical engineer, among which are 6 women.

Our Friends of the CSM Geology Museum (FCSMGM) is growing in leaps and bounds. They have ratified their By-laws and conducted field trips to Collector's Edge Minerals Inc., Cripple Creek, Dallas, and the Harding Pegmatite in New Mexico. As always, FCSMGM members receive 20% discounts in our Gift Shop. Application forms can be found at: http://issuu.com/csmgeologymuseum/docs/friends_app.

Here is the year in review. We successfully held our combined Book Sale/Garage sale last February, and a smaller one last July. We hosted a two-day XRF workshop and a three day petrified wood workshop in our conference room in July. We held many receptions from across campus and received grants from the Golden Civic Foundation and the Greater Denver Area Gem and Mineral Council. We displayed our specimens at the Tucson, Denver Guild, WIPS, Fort Collins, Colorado Springs, Socorro, Hamburg, and the Flatirons mineral shows.

We have been involved with two major infrastructure events. The first was a damaging power outage on 5/21/13 that required us to replace 50 lights/ballasts in our various display cases and ceilings, and our ventilation system blew a fan that made for a very squeaky summer, but luckily no other major electronics failed. The second was the repair of the center portion of our ceiling in our main gallery, due to cumulative rain/snow damage that was exacerbated during our heavy September deluge. That required us to close our upper floor exhibits in November for one week. It also caused our Denver Show exhibit to be stranded at our Collections Manager's house in Boulder County. On a positive note, his house was not damaged, but his commuter route and travel times were sure screwed up.

In September, we debuted nine new and four upgraded exhibits at our Annual Open House. In December, show organizers from Mineralien Hamburg paid for us to ship roughly three dozen specimens to their show, whose theme was American minerals. They flew me and representatives from New Mexico Tech, Harvard, and the Smithsonian to speak about our Museums. It was great being featured by the Germans and the few hundred brochures that I brought along describing CSM and our Museum were snatched up in the first two days!

Some of the more notable donations to our Museum this year included entire mineral collections from Stewart Towle (Met.E '54), significant funding from Jane and Marshall C. Crouch III (GE '67), William Gibbs, Jr. (GE '76), Mr. and Mrs. Robert E. Smith (GE '55), and Bob Weimer; a lovely painting from Mike and Carole Cruson (GE '65, Ph.D GE '73), wonderful minerals from Keith (GP '75) and Diane (GP '75) Brownlee, and rare meteorites from Matt (MS GE '06) and Karen (MS GE '00) Morgan. We gladly accept various geological book, map, and specimen donations throughout the year.

We held another famous (infamous?) combined Book/Garage Sale on 4/18-20/2014 from 9-4 P.M. in the Conference Room across the hall from our Museum entrance. This is a big change from past years because we were experimenting with dates that correspond with the Denver Spring Mineral Show at the Ramada Plaza (aka the old Holiday Inn), instead of what we have done the past few Februarys. Prices dropped every half day on most items.

Our Annual Open House is September 10, 2014 from 6 to 9 P.M. and we do not expect the record breaking deluge we experienced at our last open house! We are also planning a San Juan Mountains Mineral Symposium for September 16 and 17 with one day of talks and one day of field trips in the Ouray or Silverton areas, similar to what we did in Creede in 2010. Anyone wishing to help plan this event should phone me.

In conclusion, I strongly encourage you to visit our Museum. We are located two blocks north of Berthoud Hall at 1310 Maple Street. We are open Monday – Saturday 9 A.M. to 4 P.M., Sundays 1 P.M. – 4 P.M., except for certain legal and school holidays. Check out our dazzling canopy cases with new strip LEDs. View the new minerals recently purchased from the David Roter collection using funds from the David Roter Memorial Fund, augmented by Friends' contributions. Try out our new digital guest book or see our upgraded video on Golden's geology. Admission to our Museum is free, but parking fees are required in our lots and on campus streets Mondays through Fridays before 5 P.M. Further information is available on our website (http://www.mines.edu/Geology_Museum), Facebook page (http://www.facebook.com/pages/Colorado-School-of-Mines-Geology-Museum/168875179736), or phone me at 303-273-3823.

The Spanish Pyrenees

The focus of the trip was the interaction of sedimentation and tectonics of the Ainsa Basin and resultant deep-water deposits.

Left: David Pyles explaining submarine channel stacking patterns

A World-Class Geology Trip to a Medieval Spanish Town

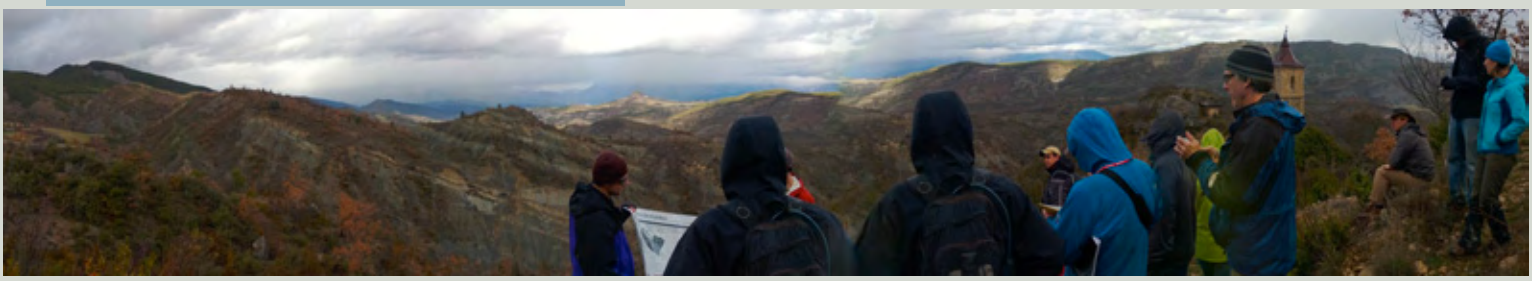
by Fabien Laugier and Evan Jones

In March (2013), a group of students led by Dr. David Pyles, several CoRE students and Dr. John Humphrey took a trip the Ainsa Basin in the Spanish Pyrenees as part of the GEOL643 course. The trip was very generously sponsored by Chevron, Aera, Anadarko, Apache, ConocoPhillips, and EOG.

Descending along winding roads flanked by almond trees and vineyards, some of us began to wonder where in this rural Spanish farmland we would find the world-class outcrops we had been promised back in Golden. We drove farther into the southern Pyrenees and low relief agriculture gave way rolling anticlines and then finally rugged valleys bound by snow-capped peaks. Our convoy of "field vehicles" (actually four-cylinder European cars with no more than six inches of clearance) finally parked in a small town, and our group hiked to the ruins of a small medieval church overlooking the whole of the Ainsa Basin. The group was now convinced.

We were standing atop the Mediano Anticline. Not only were we rewarded with the vista over the whole of the Ainsa basin, but here we could observe what we came to study: the interplay of structural growth and sedimentation and the resultant architecture of deep-water deposits. We could see the two basin-bounding anticlines, the Mediano and Boltaña, which were dominant structural controls on the basin, altering how sediment transferred to the more distal Jaca basin, and

Observing distal fan facies of the Guaso Formation



controlling the spatial changes in submarine lobes and channels. After days of coursework in preparation for the trip back in Golden, this was the payoff the students had been waiting for.

Day two began with an introduction to turbidite geology in one of the well-known Ainsa quarries. Here we could observe, in striking detail, turbidite facies, debrites, and the vertical and lateral changes of and between the two. Our lectures had introduced all the concepts of deep-water sedimentology, but it's another very different thing to be introduced to it from the rock record in front of you, rather than a field photo or illustrator diagram.

We proceeded to focus on the large-scale architectural elements; Jeremiah Moody's Master's thesis work would be the starting point. We observed basinal and slope mudstones, devoid of sand, and the transition to levee deposits, which flanked submarine channels. At Sierra de Morillo, we initially observed the channels from a distance, looking at their geometry, and how multiple channels were stacked vertically, with a minimal degree of lateral offset. As the day progressed, we hiked up onto the bluffs we had been looking at, and looked closely at the internal characteristics of these channels. Here, we were able to bring in our understanding of deep-water sedimentology gained from class, the observations we'd made from the turbidite facies in the quarry, while observing the large-scale architecture of these channels. The next step was then moving several kilometers to the NW/NE and looking at more channels at Rio Ara. Near the Boltana anticline, these new channels appeared quite different, both from the internal facies we were observing, and also on a large scale; they were now stacked differently. At this point we were able to bring a whole other dimension to our analysis: what were the effects of local structural growth on the channel configuration.

Many students at Mines have had the opportunity to visit several, if not many, exceptional outcrops; however, the world-class quality of the Ainsa Basin outcrops were not the defining factor of the trip. Rather, what made this trip particularly valuable, was the CoRE group's collective knowledge based on the work of five students, including Jeremiah and Greg who completed Master's and PhD theses, respectively, on different components of the Ainsa Basin under direction of David Pyles. The team integrated their findings into a seamless understanding of the evolution of the basin. Consistently throughout the trip we would pause and recap what we had just seen, and integrate with what we had seen the hour and day before, and in the general context of the basin. In this way, we were actually understanding the evolution of the Ainsa Basin from multiple contexts, not simply looking at the outcrops and remembering a thing or two. The point of the trip was to understand deep-water stratigraphy.

In the following days, we conducted the same, step-by-step, observation-driven assessment of the upwardly younging formations in the Ainsa. Jeremiah's channels transferred to Greg's confined, channel-lobe transitions in the Guaso Formation. Here we observed yet another major component of deep-water stratigraphy, the submarine lobe. Continuing on, we then moved higher up into the basin stratigraphy, and the basin's configuration, and focused on a complete shelf-to-slope transition in the Sobrarbe Formation. Here we directly observed the sedimentology and stratigraphy of a delta that prograded towards the shelf-edge and maintained its position there, while it directly fed submarine channels and basin-floor submarine lobes.

The trip ended with an evening in Barcelona where students could explore the city and get a feel for Spanish culture outside of the small mountain town of Ainsa. The evening was an almost overwhelming mix of Spanish art, politics, and food that mirrored the integrated course we had received in Ainsa. Sometimes being thrust into the heart of something is the best way to learn. As we reflected on the trip eating paella and tasting Spanish wine we knew when we saw some of these people later on in life, at a geology conference or maybe back in Berthoud Hall, we'd likely refer back to this trip. That was a good feeling.

IN THE HILLS

PhD student Jesse Pissel observing "Bouma" turbidite facies in the Ainsa Quarry

First view of the trip, the Ainsa Basin from the top of the Mediano Anticline

Friends of the Department

We gratefully acknowledge contributions and research funding received in the past year from our Friends and Supporters. Contributions include funding, data, software, materials, and access to areas needed for classes and research. Endowed funding continued to show better earnings. Industry giving continued to be strong this past year.

Whether people designate their funds as discretionary or for specific purposes, the funds are used accordingly. Most of the activities highlighted in this Newsletter are funded with this money. It pays for field trips connected to classes including vehicle rentals, lodging, and airfare, field camp expenses, classroom materials, lab materials, lab and classroom equipment, software, computer purchases, fellowships, teaching assistants, and many other necessities. Many of our supporters enhanced their giving by using their companies' matching gift programs.

Geology Endowment – Four years ago, the Enhancement Committee embarked upon an ambitions goal to build a discretionary endowment fund to support the Department. The school continues to face decreasing State support. We still feel it is imperative to take the funding situation into our own hands to build a secure financial future. We are proactively working toward our goal.

Thanks, again, to these supporters:

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It started out sunny and dry...

WELCOME TO GE

Annual Meet & Greet

The annual meet and greet introduces the students to faculty, staff, and other students. The meeting informs them about procedures they should know about for the school and Department, where their mailboxes are, and other vital information. The barbecue afterward is always a big hit.

SENIOR CLASS GIFT 2013

We are humbled by the dedication, devotion, and selflessness that our seniors have shown toward the Department. The funds were deposited into our Geology Education Fund, which is used in diverse ways to improve the educational experience for our students as evidenced by this *Newsletter*. We graciously salute and thank our seniors! They ROCK!!!

Percent of participation	$$ Raised	Match by President Scoggins
11.1	$448	**$448**

GEOL 501 Field Trip: Southern California, October 2013

By Andrew Heger

This past October the students of Geology 501: Applied Stratigraphy traveled to Southern California. The three day field trip, led by Dr. Piret Plink-Björklund, focused on studying outcrops of a submarine fan system and tectonic implications on sedimentation. A special thank you goes out to Statoil who generously sponsored the field trip.

Day 1

Those able to make the field trip met in the morning at DIA for the flight to San Diego. Upon arrival, the class met up with Dr. Bruce Hart, a Research Geologist with Statoil, who accompanied us on the field trip.

Once the class was organized and vans rented, we took off for Sunset Cliffs to measure sections and examine the turbidite deposits of the Cretaceous Point Loma Formation. The class reconvened atop the outcrop to discuss our observations and take-in the fabulous views.

Day 2

The second day of the field trip was spent traversing along the beach cliffs from Torrey Pines State Reserve south to the Scripps Institution of Oceanography to examine an Eocene submarine canyon complex. The first outcrops we observed were of the shallow marine Delmar Formation and Torrey Sandstone. Following a rattlesnake encounter, lunch, and a quick swim we spent some time studying the erosional surface associated with the submarine canyon floor. After a discussion of the events and processes responsible for the generation of this sequence boundary, we continued on the traverse. Heading south we observed cross cutting channel geometries and large slumps within the Ardath and Scripps Sequences. Canyons along the beach provided access to multiple outcrops where we analyzed a subaerial unconformity that separated deep-water turbidites from the much older conglomerates of the Mount Soledad Formation.

The Kernan brothers display twinning on a stratigraphy field trip.

A special thank you

The Applied Stratigraphy class extends its thanks to Statoil for providing the funding to make this trip possible and to Dr. Hart for sharing his insight and knowledge throughout the field trip. It was a great educational experience.

Describing the slope and turbidite deposits of the Point Loma Formation, Sunset Cliffs

Day 3

We began at San Clemente State Beach where we studied submarine turbidite channel(s) architecture and facies associations of the Miocene-Pliocene Monterey and Capistrano Formations. Discussions focused on whether we thought multiple laterally accreting channels or a large-single channel filled by vertical aggradation was responsible for the deposit. After lunch we traveled north to Dana Point to take a look at the Miocene San Onofre Breccia and overlying Monterey Formation. After a discussion about Miocene tectonics and impacts on sedimentation, the class concluded the San Onofre deposit is a result of the substantial relief generated from the transtensional strike-slip faulting. We wrapped up the day by measuring a section within the middle fan facies of the Cretaceous Point Loma Formation La Jolla and enjoying another beautiful sunset.

LEFT	PURPOSE	FOCUS	ABOVE
Example of an oyster bed in the Delmar Formation	High resolution observations of multiple deepwater depositional systems	The trip combines outcrop sedimentology and stratigraphy with large scale tectono-stratigraphic evolution	Dr. Plink-Björklund discussing the submarine canyon floor erosional surface

AT THE BEACH

Photo captions

Top: Close up of submarine canyon floor erosional surface

Middle: Alena and Hope checking out folded slumps in upper Ardath Fm. Above them is the erosional contact with the Scripps Fm.

Bottom: "Wave-dominate" Carl loving the turbidites in the Point Loma Fm.

Climbing ripples in the Capistrano Fm.

Discussing Miocene tectonics

NORTHERN NEVADA FIELD COURSE

By Jena Long

Colorado School of Mines offered a new graduate-level course in the Spring of 2013 on the geology and mineral deposits of northern Nevada. Dr. Elizabeth Holley held the first part of the course at CSM, focusing on the controversial origin for gold in Carlin-type deposits: is it scavenged from the host rock package by deeply circulating metamorphic or meteoric fluids? Or do the gold-bearing fluids come from coeval plutons? The second portion of the course was an extensive field trip to nine mines in northern Nevada to allow students the opportunity to debate this controversy in the field.

The field trip began with a stimulating lecture by Dr. John Muntean at the University of Nevada, Reno that included a review of Carlin-type deposits and potential deposit models. We then worked from Elko eastward back to Reno visiting open pit and underground mines. We went to five Carlin-type deposits: Barrick's Cortez mine, Newmont's Leeville, Gold Quarry, and Twin Creeks mines, and Atna Resources' Pinson mine. We also visited several contrasting deposit types: distal disseminated gold at Goldcorp's Marigold mine and porphyry related Au-Cu-Ag skarn at Newmont's Phoenix mine. At Marigold, we were fortunate to witness an impressive blast, and we enjoyed the unique opportunity to watch a gold pour as well as to hold a 1000 oz gold bar. This was quite the motivational experience for a group of still economically challenged graduate students. To see visible mineralization we also were able to visit two low sulfidation epithermal deposits: Allied Nevada Gold Corp's Hycroft mine and Newmont's Midas mine.

This trip was not only educational but also enjoyable as a direct result of the people with whom we interacted, the number of mines we were able to visit, and the fantastic variety of rocks seen. All the mines visited were characterized by the presence of enthusiastic geologists who were willing to take their time to teach and answer questions for our group. We gained valuable experience in scientific thinking as well as exposure to various mine operations, types of companies, deposits, and career options for our future. All of the individuals who were privileged to participate in this field course are grateful to Goldcorp Inc. and ATAC Resources Ltd. for their generous support that made this trip possible for Colorado School of Mines graduate students.

All smiles at the Marigold mine

ABITIBI FIELD COURSE

By Olivia Oseguera

At the end of the Spring Semester of 2013, graduate students at the Colorado School of Mines had the opportunity to take part in a field class that explored the diverse stratigraphy and mineral deposits within the Abitibi greenstone belt, a world-class gold province. The two week trip was led by Dr. Thomas Monecke with assistance from Dr. Mark Hannington, spanning from Ontario to Quebec.

We began our journey across the Abitibi greenstone belt in Temagami, Ontario, where we were exposed to our first subvertical pillow basalts, banded-iron formation, and Canadian weather. The first several days were spent in and around Temagami and nearby Cobalt observing and mapping unique volcanic and volcaniclastic facies as well as a few of the historic silver, nickel, and cobalt mining operations.

Our next stop was the town of Timmins, Ontario, where the diversity of ore deposits and volcanic settings in the vicinity kept us intrigued and curious. We were fortunate enough to visit the Kidd Creek mine, owned and operated by Xstrata Copper. Here, Tom Gemmell introduced us to the geology of this Cu-Zn VMS deposit.

Field Trips

As a Department, we are committed to educating our students in the field. The experiences of actually seeing what they learn about is essential to becoming technically sound and mature geologists. These are the experiences students remember and that have lasting value. We are grateful to those of you who provide support for our field trips and field camp.

A BAD DAY IN THE FIELD IS ALWAYS BETTER THAN A GOOD DAY IN THE OFFICE!

We were able to log one of the discovery drill cores and a representative drill core from the mine. Just outside of Timmins, the group completed a mapping exercise to illustrate the relationships between two assemblages of the Abitibi Greenstone Belt, the Deloro and Tisdale Assemblages. Later that same day, we observed spectacular spinifex textures within komatiite flows at Serpentine Hill. The quality outcrops in and around Timmins were in no short supply and we were able to see highly altered komatiite flows, highly deformed and prolate pillow basalts near the Shania Twain Center, and carbonate altered pillow basalts with the help of Erik Barr. Erik also led us on a tour of the Dome Mine in order to observe the underground operations of Goldcorp Canada Ltd. and see how the deformed volcanic facies appear below the surface.

Just outside of Timmins, in Munro Township, our group met Dave Gamble who provided us with a tour of the historically explored Potter Mine at Pyke Hill. Here we observed more spectacular komatiite outcrops, and what has been interpreted as a complex seafloor volcanic system producing a spatter rampart deposit with beautiful volcanic textures. We were also able to view high-grade drill core taken from the VMS deposit that exists beneath the old mine framework.

As we left Timmins behind, we traveled east to Kirkland Lake to learn about the local mining camp and the volcanic rocks that make up the Timiskaming Assemblage. Outcrops in Kirkland Lake yielded complex sedimentary structures, puzzling volcanic patterns, and a conglomerate made up of more rock types than we could identify in one afternoon.

Our next destination on this journey through the Archean was the Noranda Camp outside of Rouyn-Noranda, Quebec. Here our group was introduced to deposits and outcrops where volcanic massive sulfides were first understood including the Horne Mine, several deposits near Ansil Hill, the Moosehead deposit, and the deposit at LaRonde-Penna. Mapping and exploration exercises facilitated our understanding of the stratigraphy, alteration, formation, and the deposit model of seafloor massive sulfide deposits. We had to demonstrate the knowledge we gained during the course in an exploration exercise that included surface mapping and proposing a drill plan. Finally, we were able to take a tour of the intrusion-centered Malartic gold mine, owned and operated by Osisko Mining Corporation. Our group was impressed with their dedication to positive community relations and their incredible effort to relocate the entire nearby town in order to put this mine into production.

Overall, this field trip provided the students with a well-rounded look at the Abitibi greenstone belt, its structures, stratigraphy, and mineral deposits. We were able to utilize many aspects of our geology education in an applied setting in order to put together an Archean history and understand the ancient processes at work. The students able to participate on this adventurous and intensive course had a memorable and educational experience thanks to Thomas Monecke, Erik Barr, Dave Gamble, Tom Gemmell, David Pitre, Mark Hannington, and Christian Tessier. Xstrata Copper, Goldcorp Canada, Agnico-Eagle, and Osisko Mining Corp. Our thanks for their support. Continued motivation and nourishment was provided by Tim Hortons.

ABITIBI GREENSTONE BELT

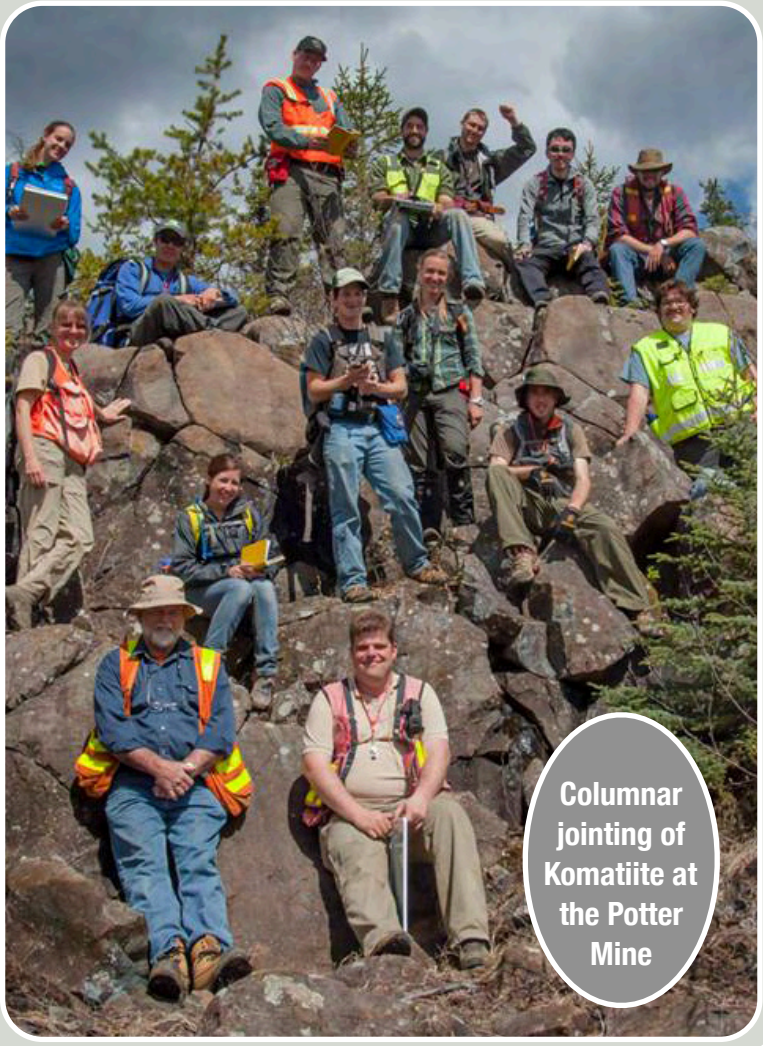
The Archean Abitibi greenstone belt of northern Ontario and Quebec represents one of the most prolific base-metal- and gold-producing areas of the world. Mineral production of well over $120 billion has come from its Cu-Zn and Au deposits.

FIELD SCHOOL

The Abitibi field school provides an overview over Archean geology in the context of several key deposit types. Students are provided with an update on current deposit models and camp-scale geological factors controlling the location of world-class deposits.

MINE VISITS

Students visit a range of world-class ore deposits including an underground visit at the Dome mine in Timmins, the logging of exploration drill core at the Kidd Creek and LaRonde massive sulfide deposits, and a visit to the open pit at the intrusion-centered Canadian Malartic deposit.



Columnar jointing of Komatiite at the Potter Mine

Faculty News and Activities

Maeve Boland was awarded a Shoemaker Award for Communication Product Excellence for two fact sheets written while she was doing her AAAS Fellowship at USGS.

The Shoemaker Awards for Communication Product Excellence recognize USGS products that demonstrate extraordinary effectiveness in communicating and translating complex scientific concepts and discoveries into words and pictures that capture the interest and imagination of the American public.

The fact sheets are available at http://pubs.usgs.gov/fs/2012/3056/ (beryllium) and http://pubs.usgs.gov/fs/2012/3024/ (nickel).

J. Frederick (Rick) Sarg received the 2013 Robert R. Berg Outstanding Research Award at Pittsburgh AAPG for his work developing concepts of carbonate sequence stratigraphy, global applications in the subsurface, and continuing education of new stratigraphers.

Stephen A. Sonnenberg is this year's winner of the Michel T. Halbouty Leadership Award, which next to the Sidney Powers Memorial Award is AAPG's most distinguished prize. First presented in 2007, it is given in recognition of outstanding, exceptional leadership in the petroleum geosciences and the Long Service Award from the AAPG House of Delegates in 2013. He was elected Vice President of the Friends of the CSM Geology Museum in 2013.

Ric Wendlandt is the 2013-14 Faculty Senate Distinguished Lecturer. His lecture entitled, "The Culture of Athletics at Mines: A Faculty Member's Perspective", will be presented spring 2014.

Wendy Zhou was honored during the April 2013 Faculty Forum as the Outstanding Faculty Member by the Senior Class of the Year in Geology and Geological Engineering.

Tribute to Eric Nelson

Emeritus Associate Professor Eric Paul Nelson died on August 27, 2013 surrounded by family, after an 18 month battle with cancer. He was 61. Eric embraced life with exceptional curiosity, energy, and enthusiasm. He was a devoted, loyal friend, mentor, teacher, geologist, skier, thinker, intellect, guitar player, humorist, traveler, partner, family member, dog lover and dog magnet, a connoisseur of good food, fine wine, art, and powder skiing. His contacts and influence extended across the globe.

His love of the outdoors was instilled by his parents at an early age by camping across the western United States, hiking in the Sierra Nevadas, the Wind Rivers, and the southern California desert. That sense of delight and wonder never ceased. His goal of skiing on every continent, unfortunately unfulfilled, indicated his true passion – skiing. It became a source of humor that in 22 years of marriage with Barb, no vacation was complete without at least one day of skiing, including skiing in the Kingdom of Lesotho, in southern Africa.

Eric grew up in California and hiked in the Sierra Nevada from an early age, turned on to nature by his family and developing an innate love of being out in it. He studied geology at Northridge, Rice, and Columbia Universities and became a professor of geology at the Colorado School of Mines. In his more than 30 years of teaching, he creatively integrated structural geology with economic geology using both fundamental as well as practical aspects of each. Eric's highly successful transition from a more theoretical structural geologist to an applied mineral economic geologist was a real inspiration for many of us. Eric spent much time in the field with his students, stressing the need for ground truthing and embracing the messy complexity of real rocks in a largely engineering-minded industry. Eric's research contributions were diverse, combining well-rounded, first-hand knowledge of global tectonics with detailed and insightfully creative field observations. Eric loved rocks and a tour of his collection at his home was like going to a museum with the most enthusiastic docent, as so many of the rocks had engaging stories. A cadre of post-docs, consultants and colleagues interacted with Eric in his constant travels from South America to Africa to Asia as he got down to the nitty-gritty of helping companies with detailed mapping and developing an understanding of key processes involved with some of the world's most interesting polymetallic, structurally controlled, vein hosted mineral deposits. Life in various man-camps at 12,000+ feet for weeks on end did not deter his enthusiasm. As part of his consulting, he presented structural workshops to numerous companies in South America, all of which were conducted in fluent Spanish (another of his many talents).

Eric and Barb traveled widely, often using Eric's various consulting trips as a starting point to explore far flung parts of the world. During Eric's sabbaticals they lived for a year each in Chile and New Zealand, exploring those regions in great detail. Between travels, he reveled in entertaining friends at home, puttering in his workshop, creating something unique that solved an exact problem, designing bizarre and hilarious Halloween costumes (his favorite holiday) and reading. One of his favorite activities was skiing with his "tele-pod" of friends at Loveland where his profound love of Colorado was exuberantly expressed in flight-like, graceful descents. He often waited for the last skier at the bottom of the run with a huge smile and ebullient words of praise for the beauty of the turns of others. Eric also was very concerned and insightful about humanity and our fate as a species in these rapidly changing

times. As an Earth scientist, traveler, and avid reader he often expressed appalled dismay about the degraded role of education in our nation and culture. He keenly recognized the importance of science as a way of knowing and generously gave his time to help promote science and rationality. As president of the Colorado Scientific Society in 2002, Eric's creativity and desire to draw in new members was reflected by inviting speakers to talk about such unconventional but alluring topics as the terroir of wine and writing forensic geology mystery novels.

Most of all, Eric was a kind friend to all. He made all who came into his life feel like they were the most important individuals. Eric was a shining spirit and gave his love and boundless enthusiasm freely and unabashedly; we all gained from his life and his graceful spirit lives on in all of us. Our Department was lucky to have him for so many years, and his influence lives on in the collegial atmosphere he worked towards and in careers of his many students. (Contributions from Barb Nevins, Jonathan Caine, Lew Kleinhans, and Murray Hitzman)

Marilyn Schwinger Retirement

After 40 years and 4 months, Marilyn Schwinger retired. Her retirement celebration was held in April with her official retirement date June 30, 2013. She served under seven department heads and five university presidents. Following are some quotes from her retirement Resolution read at the Classified Staff awards breakfast October 10, 2013.

…her dedication to the Department has been unmatched

…she was meticulous in organization, paying attention to detail, and keeping order in the Department...

…she served as department and campus historian remembering when each tree on campus was planted and in who's honor, remembering which student married whom in 1978, remembering when there were houses where Brown Building now stands, remembering when we had live snakes in the building …

…her dedication to the Department has been unmatched, and she shaped who we are, and we are extremely grateful, and there will never be another like her…

Former Assistant Department Head Greg Holden, Department Head John Humphrey, and Marilyn Schwinger

Sample Preparation Lab Remodel

In the past year, the Department's sample preparation and thin section laboratory underwent a major upgrade. Construction took place over a summer period and involved the demolition of several walls, the relocation of an electrical panel, framing and dry walling, installation of new ceilings, flooring, electrical and plumbing work, installation of a custom-built shelving system, painting, and finishing. Within weeks, the old dungeon turned into a sparkling state-of-the-art laboratory. The new facility now houses all the equipment we use for the preparation of samples for geochemical analysis, for geochronology, and thin section making. Despite the extensive refurbishment, John Skok managed to keep the laboratory going to get thin sections to our graduate students on time. What a big accomplishment!

Construction begins

The 147/148 complex was gutted. It was discovered that when Berthoud was remodeled, the old steps in the loading dock room were simply covered up with another concrete set of steps. That presented a challenge to the construction crew!

RESEARCH NEWS

Geology is done best with a warm cup of coffee at sunrise

RECENT RESEARCH KEYNOTE TALKS BY OUR FACULTY

Karin Hoal – AusIMM Geomet2013 conference in Brisbane

Reed Maxwell – American Groundwater Trust Conference on Colorado Aquifer Management in Denver

John Curtis – Energy Policy & Future Passenger Transportation Conference in Oklahoma City

Murray Hitzman – Geological Society of South Africa in Johannesburg

Engineering Geology and Geotechnics

Paul Santi, Jerry Higgins, and Wendy Zhou

The engineering geology and geotechnics program continues its robust ways, with an excellent cadre of graduate students, strong interest from undergraduates, and a vigorous research program. Drs. Jerry Higgins, and Wendy Zhou continued as full-time faculty. Dr. Paul Santi stepped into the role of interim department head in the summer of 2013 and eventually department head after an open internal search during the fall semester.

Nevertheless, Dr. Santi maintains his research program dealing with geologic hazards, predominantly debris flow analysis and mitigation. The National Interagency Fire Center is sponsoring work to minimize the social and economic impacts of post-wildfire debris flows (PhD student Kevin McCoy and MS student Ian Donovan), and the Central Federal Lands (FHWA) is funding additions to a manual for geologic hazard characterization along transportation corridors (with Jerry Higgins, and MS student Jackie Negri). Ph.D. student Joe Gartner continues his research on debris flow prediction and planning (with support from the USGS), and Holly Brunkal works to integrate climate change and peak debris flow rate prediction with the design of drainage brake systems. MS students include Mason Kreidler (effects of humidity changes on slaking and tunnel stability), Mack McClain (effects of decaying root strength on slope stability in areas of wildfire and beetle kill), and Chris Peterson (calculating debris flow avulsion potential by field mapping of cross-fan exposures). In addition to three new students, four students graduated: Casey Dowling (BGC Engineering, Edmonton), Dan Pratt (Sanborn, Head and Associates, Ohio), Michael Sweetenham (TriHydro, Golden), and Blaire MacAulay (Baseline Water Resource, Calgary).

Dr. Santi has advanced to a role as the 2013-14 Treasurer for the Association of Environmental and Engineering Geologists, continuing a five-year commitment as an officer in the Association. He was one of the organizers for an NSF-funded InTeGrate workshop entitled “Engineering, Sustainability and the Geosciences” held at CSM.

Gravel mapping near Durango, CO

FIELD TRIPS

Geological Engineering across the globe:

Top: Paul Santi pointing out Pleistocene outwash deposits to TA Amanda Rock
Middle: John Ey describing erosion mitigation of a burned area above water supply reservoir
Bottom: Field excursion on peat levee 5 meters below sea level by Dr. Robert Heck, Twente Universit Head, NL. CSM student Ben Haugen left foreground.

Dr. Jerry Higgins is in his 27th year teaching and conducting research at CSM. In 2013, he taught the senior-level Engineering Geology and Geotechnics and Geological Engineering Design courses, the surficial geology mapping problem in Durango, CO for Field Geology, and the graduate-level courses Landslides and Advanced Engineering Geology.

Dr. Higgins' research group has included graduate students Brett Arpin, Ryan Marsters, Carlos Hernandez, Paige Cybulski, and Amanda Rock. Brett finished his MS thesis work on suggested changes to the U.S. rock fall barrier testing standards funded by a NCHRP (National Research Council) in cooperation with Yeh & Associates, Denver, CO. Brett is now employed by Yeh and Associates. Ryan Marsters completed his MS thesis work on a coal mine subsidence hazards study for the Colorado Geological Survey. Ryan is now employed by Brierly Associates. Carlos Hernandez and Paige Cybulski are working on slope stability studies supported by the Director of Geotechnical & Hydrological Engineering, Newmont Mining Corporation. Carlos is nearing the completion of a revised geological model of the Carlin Formation for a deep, open pit mine in Nevada that has experienced substantial slope failures. Paige has been evaluating alternative pit slope designs to mitigate rock fall hazards for a 700m deep open pit mine. Amanda Rock is beginning a project to evaluate rock scour in dam spillways. Dr. Higgins is continuing work on the NCHRP study on rock fall barrier testing standards and asset management of barrier systems for transportation agencies in cooperation with Yeh and Associates. Drs. Higgins and Santi recently received a grant from the Central Federal Lands, Federal Highway Administration to expand a site investigation manual they produced two years ago.

Dr. Zhou has continued to conduct research on geohazard and environmental impact using GIS and remote sensing technology. Ph.D. student Matt Minnick is working on a DOE project entitled "GIS- and Web-based Water Resource Geospatial Infrastructure for Oil Shale Development". Matt is expected to defend his dissertation in 2014. He has started his job at RESPEC and was promoted to the Director of the Hydrogeology Group recently. Ph.D. student Eric Anderson's research was on the geological analysis of aeromagnetic signatures to aid in exploration of the world class Pebble Porphyry deposit, southwestern Alaska (support from USGS). He successfully defended his dissertation last fall and graduated in December 2013. Ph.D. student Ben Lowry is working on high resolution displacement monitoring of landslides and earth dams by using ground based radar interferometry, and/or ground based LiDAR. His research is part of the NSF funded SmartGeo program. He is also working as an intern at the UNAVCO and the CGG. M.S. student Jordan Garrett finished his project on landslide susceptibility analysis of Western Colorado Springs, El Paso County, Colorado and graduated in December 2013. M.S. student Ben Haugen was awarded a two-year NSF SmartGeo Fellowship starting fall 2013. He has been working on the NSF PIRE project entitled "Advancing Earth Dam and Levee Sustainability through Monitoring Science and Condition Assessment". M.S. student Celena Cui is developing a "GIS-based Nitrogen removal model for assessing the vulnerability of Florida's surficial aquifer from Onsite Wastewater Treatment Systems" with the support of Florida Department of Health.

Dr. Zhou is active in undergraduate research advising through the support of the Undergraduate Research Fellowship (REU) program and the Center for Underground Construction & Tunneling (UC&T) at CSM. Projects for undergraduates include "GIS-based 3D Subsurface Model for Queens Bored Tunnels, New York City, New York" (Robert Duran and Nathan Mollica), "Multivariate Characterization and Visualization of Fractured Rock Mass in Supporting of Tunneling Design and Construction" (Lora Hoopes), and "Three-dimensional Roughness Characterization for Concrete or Rock Surface" (Austin Wilkes).

RESEARCH FUNDING IN GE

Research funding acquired in fiscal year 2013: $5,880,576

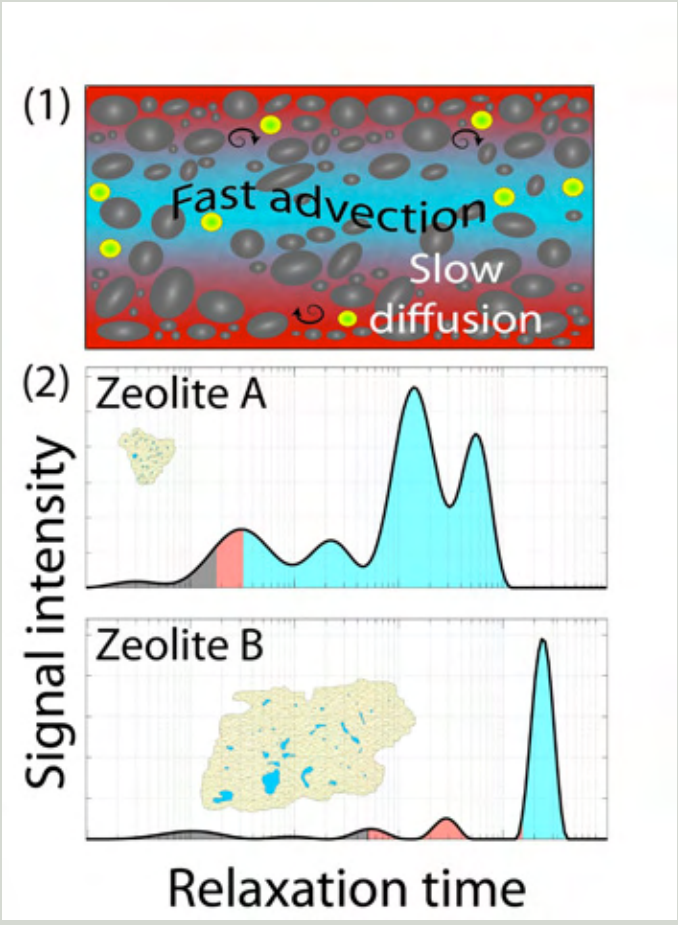
Hydrogeology

By Reed Maxwell

MODFLOW and More 2013 conference in the Green Center on June 2-5, 2013

Remediation of contaminated groundwater aquifers may require billions of dollars in cleanup costs. Part of this cost is driven by the difficulty of tracing contaminant flowpaths and limited information between monitoring wells. Geophysical methods may provide additional information between wells. (1) Our research works within a two-domain system, where the majority of contaminants move quickly within in a mobile, well-connected (blue) pore spaces, but some contaminants may diffuse into and get stuck in less-mobile, disconnected pore spaces (red) and lead to costly remediation efforts. Determining the location and volume of these less-mobile regions is essential for remediation. (2) We are the first group to use nuclear magnetic resonance (NMR) to constrain estimates of the volume of these mobile and less-pore spaces at the laboratory scale. We used two different zeolites that have substantial intragranular pore space that serves as less-mobile regions. Our NMR results shown here reveal the approximate pore size distribution and pore volume corresponding to mobile (blue) and less-mobile (red) pores. This approach allows for quick constraints of some of the important parameters controlling contaminant transport that can be later tested at the field scale with the aim to ultimately reduce remediation time and cost.

The 2014 Conference on Earth and Energy Research (CEER) organized by the Graduate Student Government was held February 26-27. Several graduate students from the Hydrologic Science and Engineering program gave oral or poster presentations. Rachel Feist, a first year Master's student in the program, was awarded the top presenter from the Hydrology program for her poster presentation on "Determining the influence of transpiration on soil moisture pathways using electrical resistivity imaging".



Left: Estimating dual-domain mass transfer parameters for contaminant transport using nuclear magnetic

Right: Lindsay Bearup collecting samples from a site north of Bear Lake

BY THE WATER

Photo Captions

Top: Jane Stammer, Ainsa Basin fieldwork

Middle: Group photo from the Ainsa Basin, Spain, Field trip

Bottom: Jeremiah Moody, Ainsa Basin fieldwork

Chevron Center of Research Excellence

By Jesse Pisel, Cathy Van Tassel, and David Pyles

The Chevron Center of Research Excellence (CoRE) is a unique academic-industry partnership between the Colorado School of Mines and Chevron Energy Technology Company. CoRE research addresses some of the challenges faced by Chevron in the exploration, production and development of shallow marine, fluvial, and deepwater petroleum reservoirs. Founded in 2003, the CoRE program is directed by Dr. David Pyles and managed by Cathy Van Tassel. Part-time research associates Linda Martin and Mark Kirschbaum continue to support and contribute to the team.

In 2013, two CoRE students completed their research. Kassandra Sendziak graduated with her MS degree Spring 2013 and began work as a Geologist with Anadarko Petroleum Corporation in Denver, CO. Kasi's research focused on stratigraphic architecture in the Lower Wasatch Formation, Utah. Greg Gordon successfully completed requirements for his PhD degree; he will graduate Spring 2014. His dissertation focused on the confined deepwater systems of the Guaso and Modello Formations in Spain and California respectively. Greg's research results will be published soon; he has one article in review and two in press. Summer 2013, Greg began work as an Exploration Geologist for Aera Energy LLC in Bakersfield, CA.

Currently, the team has six graduate student researchers and two undergraduate assistants. Jeremiah Moody, Jane Stammer, and Jesse Pisel continued to advance their PhD research in 2013. Jeremiah spent another field season in the Escanilla Formation of Ainsa Basin, Spain; he is writing up the results from all his fieldwork with his eye on graduation Spring 2014. Jane spent time this year working with Dr. Kyle Straub, Tulane University, analyzing data from her previous experiments and has started writing up the results. Jane also plans to graduate Spring 2014. Jesse Pisel spent a field season in Utah mapping fluvial channel belts in the lower Wasatch Formation; he continues to analyze data and document early research results. Matthew Andresen, Bradley Nuse, and

Utah fieldwork l-r: Jese Pisel, right Cole Rosenbaum

Kimber O'Brien, the team's three new MS students, joined CoRE this Fall. Matthew holds an undergraduate degree in Geology from Wheaton College and an MS degree in Environmental Management and Forestry from Duke University. His research focuses on three-dimensional stratigraphic analysis of a shallow marine system in the Neslen Formation, Colorado. Bradley holds an undergraduate degree in Geological Engineering from Mines and has successfully transitioned from supporting the team as an undergraduate researcher to graduate student. His research focuses on three-dimensional fluvial architecture in the Cedar Mountain Formation, Utah. Kimber graduated from Mines with a degree in Geological Engineering and spent the summer working as a CoRE undergraduate assistant helping Jane with sample preparation before she joined the team as a graduate student. Kimber's research focuses on stratigraphic analysis and three-dimensional interpretation of the Neslen Formation, Utah. Kimber and Matthew are working closely with Mark Kirschbaum and Dr. Pyles to develop CoRE's new shallow marine research focus area. Undergraduate assistants Cole Rosenbaum and Ben Dellenbach assist the team with a variety of research and field related tasks.

The past year was full of activity for CoRE, the team: logged 160 person days of fieldwork in Utah, California, and Spain; presented posters and talks at a variety of meetings; and published research results. Members of the team presented three posters at the Pacific Section of the American Association of Petroleum Geologists (PS-AAPG) annual meeting, three posters at the Geological Society of America (GSA) annual meeting, and two posters at the American Geophysical Union (AGU) annual meeting. Dr. Pyles gave an invited lecture at the Gulf of Mexico Deepwater Technical Symposium and presented talks to the AAPG student chapter. Jane Stammer gave an invited presentation at the Robert J. Weimer Symposium – "New Frontiers in Sedimentary and Petroleum Geology" at Mines. Dr. Pyles and Jane Stammer, in collaboration with Tulane University colleague, Dr. Kyle Straub, published an article on hydrodynamic fractionation in Geophysical Research Letters. Dr. Pyles was an author on an article on salt tectonics and Pliocene stratigraphy in Marine and Petroleum Geology and an article on piping of coarse-grained sediment in Journal of Geophysical Research Earth Surface. He has three other articles in press and two in review. Four additional peer-reviewed articles have been accepted for publication or are in press, with CoRE alumni Grace Ford and Greg Gordon each as first authors on articles. CoRE alumni and graduate students (Gordon, Ford, Hoffman, Moss-Russell, Silalahi, Moody, Stammer, and Pisel) also have two articles in review and 13 articles in prep.

In 2013, the CoRE Education Series continued to extend its influence across campus. The series brought world-class speakers to campus including Dr. Marek Kacewicz who discussed the complexity of carbonate reservoir modeling. Additionally, Dr. Pyles, Dr. John Humphrey, Greg Gordon, and Jeremiah Moody taught a field-based class on tectonics and sedimentation in the Ainsa Basin, Spain. Research from multiple CoRE alumni was incorporated into the course along with insights into the carbonate system by Dr. John Humphrey. The course culminated in a week-long field trip to Ainsa, Spain. Additionally, Mark Kirschabaum and David Pyles led field trips for the AAPG student chapter. In the Spring, Mark led 16 graduate students on a trip to the Book Cliffs Formation. During the Fall semester, David led a trip for 17 students to the Lewis Shale Formation in Wyoming.

All in all, CoRE has had another very successful year! We look forward to success in 2014 as our research in all the siliciclastic depositional environments from fluvial, to shallow marine and deepwater continues. We are excited to add fresh talent to the team through new PhD students starting Fall 2014.

Center for Oil Shale Technology and Research (COSTAR)

By Jerry Boak, Director

The Center for Oil Shale Technology and Research (COSTAR) has completed the first year of its third two-year phase, with Total continuing to support the research program. The COSTAR team has extended its integrated geologic framework for the Green River Formation in the Piceance Basin and Uinta Basin. The team also improved understanding of the Greater Green River Basin, and completed its collaboration on the Uinta Basin with researchers at the University of Utah and the Utah Geological Survey.

Rick Sarg, Kati Tänavsuu-Milkeviciene, Suriamin (former grad student), and John Humphrey published a paper n the AAPG Bulletin entitled "Lithofacies, stable isotopic composition, and stratigraphic evolution of microbial and associated carbonates, Green River Formation (Eocene), Piceance Basin, Colorado". Ryan O'Hara defended and completed his M.S. thesis. Sheven Poole successfully defended her M.S. thesis. Tim Lowenstein and Eliot Jagneicki at Binghamton University published "Experimental study of shortite ($Na_2Ca_2(CO_3)_3$) formation and application to the burial history of the Wilkins Peak Member, Green River Basin, Wyoming, USA" in Geochimica et Cosmochimica Acta.

We have submitted revised versions of two manuscripts to a volume on the Green River Formation summarizing the stratigraphic and mineralogical interpretations. Tengfei Wu and Cory Sharp are working on COSTAR projects involving geochemical and petrologic studies.

Kati Tänavsuu-Milkeviciene and Rick Sarg partnered with Paul Wright of BG Group on a field course titled Sedimentology and Stratigraphy of Lacustrine Systems: Reservoir and Source Rocks, Great Salt Lake and Green River Formation (Utah and Colorado, USA) for Nautilus World Limited of Houston. Jeremy Boak also was an invited participant of a wrapup plenary session International Oil Shale Symposium in Tallinn, Estonia in June.

In addition, the Geomechanics team in COSTAR has advanced understanding of the physical properties of oil shale and begun development of models to understand how the shale will fracture under the stresses of in situ pyrolysis of oil shale. Steven Geer, working under Graham Mustoe (Engineering) has successfully defended his Ph.D. proposal, and is working on discrete element and homogenization-

based approaches for the mechanical properties of geomaterials. Mike Batzle (Geophysics) and his team completed a limited suite of measurements of seismic velocities of oil shale at ambient and elevated temperatures.

The new Green River consortium (ConocoPhillips, Devon, EOG, Bill Barrett, Newfield, Andarko, and Statoil) is underway, led by Rick Sarg, Piret Plink-Björklund and Jeremy Boak. The consortium is focused on stratigraphic and sedimentologic studies of the Green River and Wasatch formations related to oil production in the deeper basin. Six graduate students are working under the consortium.

33rd Oil Shale Symposium

by Jerry Boak

The 33rd Oil Shale Symposium held at the Green Center at the Colorado School of Mines from October 14-16 highlighted progress in research and development of oil shale resources in the U. S. and around the world. More than 200 delegates from 17 countries and 17 states in the U.S. attended the two and one-half days of sessions on science, engineering, environmental, socioeconomic and policy issues relating to potential production of oil from oil shale.

On the opening day, the plenary program was abbreviated by the Federal shutdown; a talk by Mitchell Leverette of the U. S. Bureau of Land Management was not presented. However, Troy Cook of the U. S. DOE's Energy Information Agency (EIA) had recorded a talk before being furloughed, and discussed the oil and gas production model of the EIA with specific reference to oil shale. David Argyle of London Investment Partners discussed challenges and opportunities for oil shale developers. Symposium Co-Chair Jerry Boak presented a status report on the industry, suggesting the possibility of production >400,000 BOPD by 2030. The plenary session continued with a panel discussion on the social license for oil shale development moderated by Jason Hanson of the Center of the American West at UC Boulder involving representatives of government, industry, academia, international companies and environmental NGOs that was a hit with many of the attendees.

The technical sessions included presentations from international oil and oilfield service companies like ExxonMobil, Shell, Total, and Schlumberger, from national laboratories (Idaho National Laboratories), from companies and universities in Estonia, China, Jordan, Israel, Canada, Australia, and Morocco, from U. S. universities and independent oil shale companies, and from the U. S. and Utah geological surveys.

World production has increased to 35,000 BOPD, and further increases are likely over the next 2-5 years, with new retorts under construction in Estonia and China. Total is partnered with two American companies to test both surface retorting and in-situ methods for production in the U. S, with a surface test likely to begin before the end of 2014.

The U. S. Geological Survey presented results of analysis of the distribution of dawsonite and analcime in the Piceance Basin. Water use remains a hot topic for oil shale, and Shell presented results of their efforts to reduce water use. They also presented a summary of their environmental efforts in Colorado, just after the announcement that the company would withdraw from oil shale development in Colorado, while maintaining efforts in Jordan. Harold Vinegar made a presentation on the early in-situ production experiments in Sweden, where oil was produced from oil shale in a horizon only five meters above an aquifer, with no contamination. Schlumberger presented results of pyrolysis experiments on the Green River Formation that highlighted the remarkable richness of the gas produced, which contains more than double the heavier content of wet gas from the Eagle Ford. Enefit presented results of work in Utah, Estonia, and Jordan.

Mines and GE were represented with talks by Jerry Boak from GE, and Julie Carmen of the Arthur Lakes Library. Julie led a tour of the Tell Ertl Oil Shale Repository, which provides the largest collection of oil shale documents and materials in the world, and is increasing its digitized holdings and links to other digital resources. And Neal Sullivan of the Colorado Fuel Cell Center gave tours of the Geothermic Fuel Cell project at the GRL.

The Oil Shale Symposium is the premier international conference on the development of oil shale, which could potentially add another three trillion barrels of oil to global resources. For more information, see past Symposium Proceedings at:

http://www.costar-mines.org/oil_shale_symposia.html and the 33rd Oil Shale Symposium program (with hyperlinked abstracts) at: [check weblink]

http://mines.conference-services.net/programme.asp?conferenceID=3190&language=en-uk

Field Trip to the Lewis Shale and Fox Hills Sandstone, Wyoming

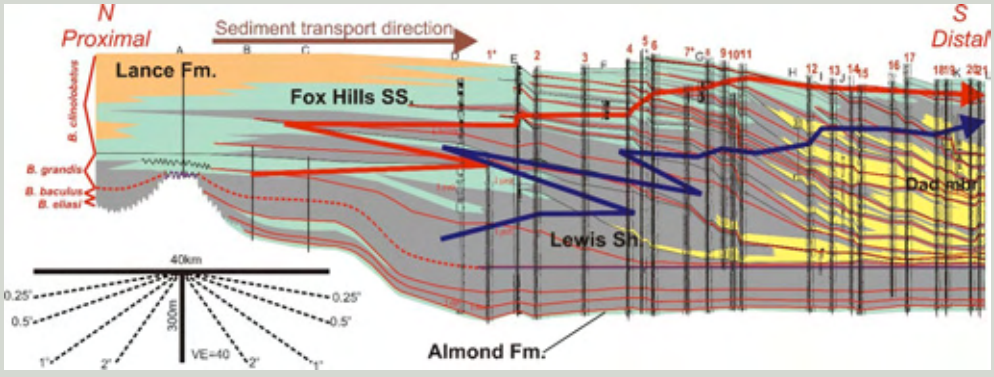
by Mustafa Al Ibrahim and David Pyles

The Chevron Center of Research Excellence (CoRE), in association with CSM-AAPG Student Chapter, hosted a student field trip to the Lewis Shale and Fox Hills Sandstone of southern Wyoming September 20 through 22, 2013. The field trip focused on the stratigraphic architecture of a prograding shelf-slope-basin system and was led by Dr. David Pyles, the Director of

CoRE, who has extensive experience in the area. This trip was important because prograding shelf-slope-basin depositional systems host important oil and gas reservoirs on many of Earth's continental margins such as the North Slope of Alaska, the northwestern shelf of Australia, Green River Basin of Wyoming, Sakhalin Island, and Porcupine basin - and it is likely that many of the participating students will work on these types of systems during their career in the oil and gas industry. As such, the goal of the field trip was to expose students, first hand, to down-profile (fluvial, shelf edge, slope, base of slope, and basin floor) changes in stratigraphic architecture, source rocks, traps and seals. The trip integrated outcrop, well log, core, and seismic data - allowing one to observe how stratigraphic features are manifested in these different data sets. A side benefit to the trip was its timing early in the fall semester which allowed incoming and returning students to get to know each other and form strong bonds early-on in the semester.

The field trip was kicked off with two pre-trip meetings. The first was a lecture hosted by the AAPG Student Chapter, which focused on the geology of the field area and key goals of the field trip. The second focused on field-trip logistics and geological processes, such as sediment gravity-flow processes and products. During the field trip numerous exercises were assigned. In the field, group exercises required students to make observations and interpretations at different scales (from centimeter-scale lamina to kilometer-scale sequences). At the hotel, a core exercise, which utilized a behind-outcrop core and associated well logs (CSM Strat. Test 61) and other cores and associated well logs from the basin, allowed students to relate observations made in the field to subsurface data sets. A concluding exercise required students to integrate all of the observations into a single document.

This field trip would have not been possible without the generous financial contributions from the industry. Specifically, we thank Apache, Chevron, Hess, Marathon, and Nexen for the financial support. CSM-AAPG Student Chapter also thanks Dr. David Pyles, CoRE Director, who led the field trip, and Cathy Van Tassel, CoRE Program Manager, who handled most of the field-trip logistics.



IN THE FIELD

Photo Captions:

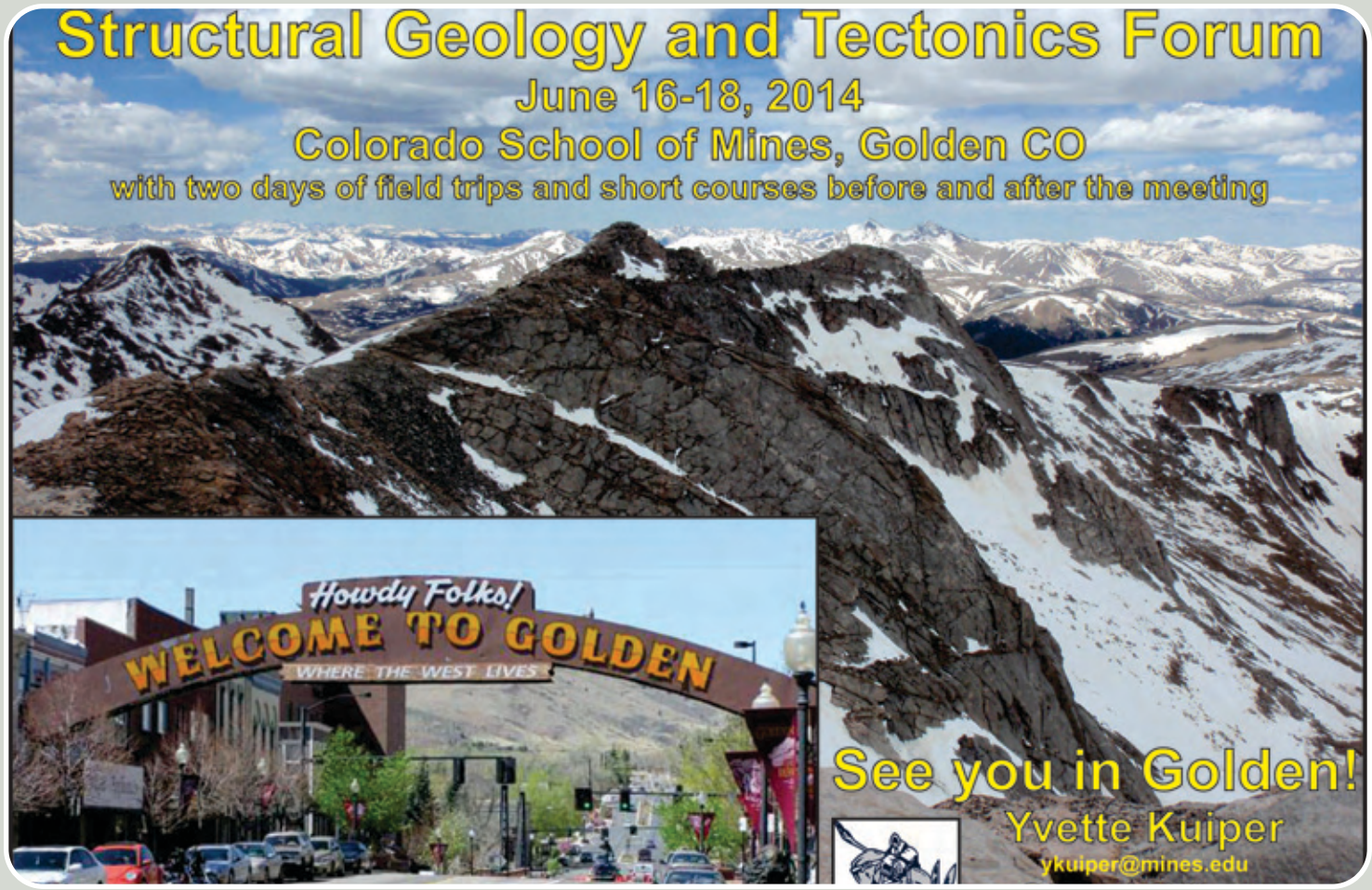
Previous page: The group discussing an outcrop in the area.

Left top: Lewis Shale and Fox Hills Sandstone 2013 field group

Left Bottom: Regional cross-section through the Lewis Shale and Fox Hills Sandstone (Pyles and Slatt, 2007)

Top: David Pyles explaining the stratigraphy of the area

Bottom: Students admiring a slump deposit



Structural Geology and Tectonics Forum

This is the 3rd biennial Structural Geology and Tectonics Forum. The Forum provides an informal and interactive venue for discussing important frontiers, new ideas, and current research in structural geology and tectonics. The Forum also provides opportunities to discuss effective teaching of structural geology and tectonics, including integrating research with teaching. The three-day Forum will be bracketed by two optional days of workshops and field trips. Although the Forum is aimed at professional geologists, advanced graduate students are encouraged to attend.

CSM Participates in Southern Africa Geological Training Workshop

Murray W. Hitzman

Murray Hitzman, the Charles F. Fogarty Professor of Economic Geology, was one of five prominent academics who taught a workshop on “Base Metals in Basins” in Kitwe, Zambia 17-21st June 2013. The workshop attracted 53 delegates from 14 countries and 20 mineral exploration companies. The vast majority of the delegates were young Africans working in mineral exploration. The highly successful workshop was a dream come true for Hitzman who has been working in the Central African Copperbelt for over a decade but who has had difficulty convincing companies to sponsor African students at CSM.

Dr. Stephen Roberts (University of Southampton, UK), Dr. Philippe Muchez (K. U. Leuven, Belgium), Dr. John Walsh (University College, Dublin, Ireland), and Dr. Jamie Wilkinson (Imperial College, UK) also served as instructors and Dr. Mike Richards (Barrick Gold), Dr. Dave Wood (First Quantum Minerals Ltd.), and (now Dr.) Dave Broughton (then CSM PhD candidate - Ivanplats) also contributed.

While the workshop involved several days of traditional lectures and break-out study groups, it also included two days of core logging exercises at the Kalalushi core shed, Kitwe which is a spectacular archive of Copperbelt geology, and a day mapping in the new open pit at the Nkana deposit (Mopani mines).

One day was spent examining a series of cores at Kalalushi which characterised the stratigraphic setting of the Zambian and Congolese Copperbelt orebodies. Workshop delegates were divided into groups to log core and address the key questions. This helped them gain a better appreciation of the geology and prevented the establishment of any “company silos” during the week-long event. Another day at the core shed was spent examining a series of cores from different ore deposits in the Central African Copperbelt including Lumwana, Samba, Mufulira, Chambishi, Mwambashi, Mwinilunga, and courtesy of Dave Broughton and Ivanplats, a representative core of the recently discovered Kamoa Deposit in the DRC.

Murray about to reveal the answer to a core exercise

Portion of group in Nkana pit

The exercises highlighted the variety of deposits in the district but also demonstrated underlying similarities despite differences in stratigraphic setting, host rocks, and metamorphic grade. Presentations by each of the groups ensured that they had to work out problems and then present their results to their peers. Exploration activity in the Central African Copperbelt remains strong, with new mines being developed and major new discoveries recently made. However, training of young African geologists remains a concern. This workshop provided a means of trying to bridge the gap between the research work CSM has been doing in the region for many years and pragmatic training needs.

Feedback on the workshop was extremely positive. One delegate wrote: “The workshop was one of the best that I’ve ever participated

Murray with students at Kalalushi

in 10 years of professional life. I believe that you guys had found the right structure for future events." Another stated, "Almost 50%/50% field work and class room lectures! It was good and passed very fast. We learned a lot, in particular on the variability of ore formations and hypotheses! It just reminds us as geo's to keep an open eye and integrate all data set." Finally, "The workshop structure was fantastic. I personally enjoyed that while looking at the core you guys assigned tasks that made our observation of the rocks, alteration and mineralization styles and discussion about stratigraphic positioning much more objective." It was humbling to see the level of effort and engagement of the younger geologists during the event and, in particular, during the core and mine visits.

Geodynamics and Ore Deposit Research Group

By Steve Enders, Murray Hitzman, Elizabeth Holley, Nigel Kelly, Yvette Kuiper, Thomas Monecke, Katharina Pfaff, and Richard Wendlandt

Greetings from the Geodynamics and Ore Deposit Research Group! Another year flew by. Once again we pushed the limits of field and analytical research a little further, explored new parts of the world, initiated new projects and had students thrive in their studies and their careers beyond Mines.

It was the first year for Elizabeth Holley as a new faculty member in our Department. Over the year, she focused primarily on expanding the Professional Master in Mineral Exploration program that is designed for young working professionals returning to school. Elizabeth designed a number of new courses that fill critical needs in this program, including reflected light and electron microscopy, a field course that takes graduate students to northern Nevada (see article in this Newsletter), and a set of high-level courses that focus on specific deposit types. The graduate courses that Elizabeth now teaches, as well as those taught by other faculty in our group, give students the opportunity to enhance their understanding of geologic processes and techniques to become top-tier geologists and explorers. We currently have 13 Professional Master students from the United States, Latin America, and the UK. As there are very few graduate programs designed specifically for geologists working in the mineral exploration industry, our multi-disciplinary program fills an important need globally. In the future, we will expand this unique program substantially and recruit new students from all corners of the world.

We are a large and vibrant research program with a total of six students in the Doctor of Philosophy program and 21 students studying towards a Master of Science degree. Moreover we are currently searching for a tenure track Lithogeochemist. Faculty members are traveling the world to advise students in their respective field areas, meet our partners in industry and government, serve on committees and boards of various organizations and professional societies, and attend meetings and conferences. Especially during the summer, it is more likely that you will meet us at some airport than in our offices!

Murray Hitzman spent much of his time on research in the Central African Copperbelt and expanded the field area to northwest Botswana where he is now working on Rapitan-style Neoproterozoic iron formations associated with the Sturtian "Snowball Earth" event. During the past year, two of Murray's Doctor of Philosophy students working in the Copperbelt completed their degrees. He also graduated three Master of Science students working in southern Africa. A highlight of the work in southern Africa during this year was a field-based class he taught for young African geologists (see article in this *Newsletter*). Murray also worked on iron oxide-copper-gold and carbonate-hosted Zn-Pb deposits with other graduate students and is still pursuing research on rare earth element deposits. In addition, he enjoyed his work on public policy in Washington, D.C., much of which focused on induced seismicity associated with energy production in the United States.

Ric Wendlandt's research activities included several studies dealing with controls on rare earth element mineralization. With three Master of Science students, he worked on magmatic and weathering aspects of the Mountain Pass carbonatite and Bear Lodge carbonatites, respectively. One student is initiating an experimental investigation of cation exchange behaviors of REE's on clay mineral surfaces. Another student has completed her research, which is supported by MMG Limited, on the petrogenesis of Keweenawan mafic and ultramafic dikes and will be defending her thesis later this semester.

Yvette Kuiper, Thomas Monecke, and Nigel Kelly combined their expertise and started an ambitious project in the Abitibi greenstone belt of Quebec and Ontario to solve some of the outstanding questions on Archean tectonics. Over the summer, they looked at some spectacular outcrops of Archean volcanic rocks, including some unbelievably differentiated komatiite flows, and tried to understand places that have seemingly impossible geology. They currently have one Doctor of Philosophy, four Master of Science, and two undergraduate students involved in this project.

Yvette Kuiper continued her research in Eastern Massachusetts that is in part supported by the National Science Foundation CAREER program. Her Appalachian research group increased in size and she has currently one Doctor of Philosophy, two Master of Science and one undergraduate student working on the project. She also started diving more into Colorado geology. In fall, she taught a field course for graduate students in the Front Range, where students wrote a proposal, conducted their own proposed research, and wrote up the results. One team even presented their results at the Vancouver Mineral Exploration Roundup! Yvette is in for a busy but fun upcoming summer as she is organizing the Third Biennial Structural Geology and Tectonics Forum together with Chuck Kluth. This is a three-day forum with two days of field trips and short courses before and after the meeting. Please join! Details can be found at http://serc.carleton.edu/NAGTWorkshops/structure/2014_Forum_index.html.

Over the past year, Thomas Monecke and his students conducted a number of studies on ore systems hosted by arc volcanic successions. This included extensive field work in the Abitibi greenstone belt, which included detailed mapping of the host-rock successions of the Horne and Quemont

massive sulfide deposits. Besides his ongoing research in this part of the world, he taught his Abitibi field school that introduces our graduate students to Archean geology and teaches them a wide range of mapping and logging techniques. Thomas also continued his work on the cathodoluminescence and fluid inclusion inventories of quartz occurring in porphyry and epithermal deposits. Together with a graduate student and adjunct professor Jim Reynolds, he studied samples from some of the most famous porphyry deposits in the world, including Bingham Canyon, Butte, and Chuquicamata. As part of his adjunct appointment at the University of Ottawa in Canada, Thomas delivered a two and one-half day short course on the physics and chemistry of hydrothermal ore deposits in February. His short course on hot fluids was well received during the coldest month of the year in the Canadian capital. Thomas also served as a co-editor for two issues of Economic Geology and is heavily involved in the organization of the Society of Economic Geologists Keystone 2014 that will bring together hundreds of professionals from industry, academia, and government at the end of September (see http://www.seg2014.org/).

Nigel Kelly continued with his research that crosses from pure basic research on geologic processes through to applied geology on mineral deposits. Much of his work this year focused on the behavior of dateable accessory minerals, like zircon and monazite, within various geologic environments and the impact these minerals have on trace element cycling in the crust. He completed a major research project supported by the National Science Foundation. Work is also ongoing on various industry-sponsored projects, including the Whistler porphyry Au-Cu deposit in Alaska, the Cripple Creek epithermal Au-Te deposit in Colorado, and Cu and Ni ore deposits in the Central African Copperbelt.

In addition to her responsibilities for the Professional Master in Mineral Exploration program, Elizabeth Holley conducted research on the fluid evolution in the porphyry and epithermal environments, through collaborations with Thomas Monecke and colleagues at the University of British Columbia. She is also examining the role of magmatic processes in Carlin-type deposit formation, starting this year with a new MSc project at the Marigold mine. As part of her role as teaching faculty, Elizabeth is

Marveling over a unique exposure of komatiites at the Potter Deposit

AT THE MINE

Photo Captions:

Top: L-R P. Quigley, S. Ball, T. Gonchig and J. Cervera at the Edgar Mine during Dr. Kuiper's Structural Geology Field Course
Middle: Studying core at the Kidd Creek mine, Abitibi region, Canada
Bottom: Wes Buchanan (l) and Ben Frieman (r) holding silver bars in the Cobalt Mining Museum, Abitibi region, Canada

experimenting with new pedagogical techniques in the classroom and the field, working to identify innovative ways to enhance our undergraduate and graduate curricula.

The focus of the QEMSCAN Facility, overseen by Katharina Pfaff, is to provide improved understanding of materials to better predict their management, development, and the effective recovery of resources. Part-time lab assistant Carla Sanchez produced 280 epoxy mounts and Katharina Pfaff and part-time lab assistant Matthew Dye spent 1385 hours analyzing these samples and interpreting results for industry and research. The biggest accomplishment was the development of a highly successful definition list for various REE-minerals for use in automated mineralogy. Besides development work, research in the laboratory covered a wide range of geological processes, from the formation of base and precious metals to igneous petrology.

Steve Enders continued as Director of the Center for Innovation in Earth Resources Science and Engineering, which is funded by Newmont Mining Corporation. The center has had 19 projects since starting up in January 2010 including two projects with Stuart Simmons on the potential for geothermal energy development at the Midas Mine in Nevada, and a project with Thomas Monecke on the use of fluid inclusions and cathodoluminescence to identify hydrothermal quartz in stream sediment samples as a guide to Cu and Au exploration. In addition to his work for the research centre, Steve chaired a workshop on the geology of the Kalahari Copper Belt in Maun, Botswana in July. Steve also lectured at CSM and elsewhere in the world in his role as an Honorary Lecturer for SEG. Besides his involvement in research and teaching, he is a director and executive with Eurasian Minerals Inc. and Cupric Canyon Capital LLC.

The success of our research group is in large part built on the quality of our students and all the hard work they perform. Furthermore, we had numerous graduate students defend their thesis successfully. David W. Broughton, Eric Anderson, Jessica Matthews, Julie Leibold and John Woodhead now can be called 'Doctor'! Our MSc graduates are Patricia Capistrant, Michael Hendrickson, Nicholas Kerr, Anne Rahfeld, Wesley Hall, Tim Stockhausen and Owen Nicholls. Furthermore, Pamela Lagrava Zamorano graduated from the Professional Master program. Congratulations to them all!

Despite the current down-turn in the industry, most of our graduate students already have job offers and, without doubt, will move on to rewarding careers. Clearly, Mines attracts some of the best and brightest students in our field.

The outstanding quality of our students is also reflected by the large number of prestigious grants and fellowships they have been awarded. Jae Erickson, Halley Keevil, Jena Long, Olivia Oseguera, Helen Thomas received Society of Economic Geologists Fellowships. Robby Charnock and Ben Frieman were awarded Geological Society of America Student Research Grants. Douglas Conner, Ben Frieman, Mario Guzman, Christopher Olson, and Justin Palmer had support from Society of Economic Geologists Student Research Grants. The students' enthusiasm also shows in the SEG student chapter, which is active with field trips, short courses and invited speakers as ever (see article in this Newsletter).

Besides conducting research on their theses, our students participated in a wide range of conferences, presenting posters and talks. This included the Vancouver Mineral Exploration Roundup, the meeting of the Prospectors and Developers Association of Canada in Toronto, the Geological Society of America meeting in Denver, and the Society of Economic Geologists conference in Whistler. For the first time, we presented a booth at the Society of Economic Geologists conference to keep in contact with alumni and friends and to recruit potential students. It was a great experience for our graduate students staffing the booth together with Elizabeth Holley, Thomas Monecke, Katharina Pfaff, and Steve Enders. You will see us again in full force at Keystone.

Matt Dye (left) and Jae Erickson (right) driving the Qemscan

Many of our activities rely on the help by our alumni and friends as well as our industry partners. Most notably, we again received an extraordinarily generous donation from Goldcorp that we will support three undergraduate students in our Department and three undergraduate students in the Department of Mining Engineering. We also appreciate a substantial gift by Goldcorp that helps us to train our graduate students in the field.

Last but not least, we are sad to report the loss of our good colleague and friend Eric Nelson. He died on August 27, 2013, after a brave battle with cancer (see obituary earlier in the *Newsletter*). We will remember him for his incredible passion for fieldwork, his mentoring skills with students, his exuberance, and warm humor.

Despite this sad news, we wish you, the alumni and friends of our Department, all the best for the upcoming year! If you are in Golden, please feel free to stop by to talk to us and our students. We always love to hear from you.

Consortia: Bakken, Niobrara, Vaca Muerta, and Eagle Ford

By Steve Sonnenberg

Steve Sonnenberg's research includes sequence stratigraphy, tectonic influence on sedimentation, and unconventional petroleum

systems. His current research focuses on the Bakken Petroleum System in the Williston Basin, Mancos Niobrara Petroleum system in the Rocky Mountain basins and the Vaca Muerta Mudrock in the Neuquén Basin, Argentina. Steve is also involved in the UNGI Eagle Ford study.

The Bakken project focuses on the stratigraphy, structure, diagenesis, burial history, mineralogical distribution and petrophysical properties of the Bakken Petroleum System. The research is funded by a 30-company industry consortium. Geology students working on the Bakken include: Aaron Bazzell, Steve Brennan, Ellen Fehrs, Alyssa Franklin, Katie Kocman, Gary Listiono, Dipanwita Nandy, Tony Rios, and Spencer Roulfs. Henriette Eidnes, Cosima Theloy, Claudia Gutierrez, Dylan Cobb, Rebecca Johnson and Hui Jin finished thesis projects in 2013.

The Niobrara industry consortium was started in September 2010. The Niobrara project will focus on stratigraphy, structure, fracturing, diagenesis, burial history, and petrophysics. There are 35 companies involved in the study. Niobrara students include: Andrew Heger, Elena Finley, Nick Matthies, Nico Kernan, Zane Houston, John Harper, Denton O'Neal, Devin Murray, Steve Crouch, Rana El Ghonimy, and Jennie Rietman. Tofer Lewis, Arman Kaykun, Tom Arthur, Martin Kruger, David Underwood, and Kelly Bruchez finished thesis projects during 2013.

The Vaca Muerta study was initiated in 2012. The study will focus on stratigraphy, structure, fracturing, diagenesis, burial history, geomechanics, best drilling practices, and petrophysics. Co-PIs in the study are John Humphrey, Azra Tutuncu, Todd Hoffman, and Bill Eustes. Vaca Muerta students include: Alex Betancur, Ted Kernan, Eider Hernandez-Bilbao, Max Willis, Matt Herzog, Talgat Kosset, and Anton Deben Padin.

Eagle Ford students include: Alex Gibson, and Anton Deben Padin.

Olusanmi (Tunde) Emmanuel finished his PhD thesis on the Marcellus Shale. Zach Hollon is currently working on a Mowry thesis.

Kathy Emme was hired in 2011 as a research associate to help with consortium projects (Bakken, Niobrara, Vaca Muerta, Eagle Ford). She is paid through Consortium Accounts.

Related to consortia research, Steve Sonnenberg presented talks at AAPG, GSA, WGA, URTEC, Annual Meeting of AIPG, and the Bakken completions congress. Field trips conducted by Sonnenberg in 2013 included multiple Mines Geology Trail trips and one geologic raft trip in the Grand Canyon. Steve was awarded the Michel Halbouty Leadership Medal from AAPG and the Long Service Award from the AAPG House of Delegates in 2013. He was also elected Vice President of the Friends of the CSM Geology Museum in 2013.

Bakken Consortium students and professors

Vaca Muerta consortium students and professors

Niobrara Consortium students and professors

NEWS FROM ROCKY MOUNTAIN PTTC (PETROLEUM TECHNOLOGY TRANSFER COUNCIL)

By Dr. Mary Carr

It has been another great year for PTTC here at Mines. We held 21 workshops throughout the year, including some in conjunction with Rocky Mountain Association of Geologists and Montana Geological Society. We also exhibited at three national meetings. With attendance at our events at approximately 800 this year, we have seen a steady increase in attendance numbers over the past several years. We are looking forward to another busy year working with RMAG, MGS and the Rocky Mountain Section of AAPG.

Hugh Reid's DST Course attendees May 2013, CSM

The Futures in Energy program returned to Colorado School of Mines this year. Futures in Energy is an industry outreach program that offers training in oil and gas technology for talented high school juniors and seniors. After a three year hiatus, we were excited to get the program moving again. The program took place on June 17-21. Twenty-four high school juniors and seniors shared a hands-on introduction to oil and gas exploration and production technology. The five-day interactive training on-campus at the Colorado School of Mines (CSM) utilized the excellent curriculum provided by the Denver Earth Science Project. The program took students from outcrops along Dinosaur Ridge to Ensign Energy Services' training facility giving them an opportunity to experience many aspects of the industry. Andy Leonard served as instructor, and students attended from all over Colorado as well as Bakersfield, California. As always, the field trips were the highlight of the program (see photo).

For several years, the Rocky Mountain PTTC has enjoyed the unwavering support of volunteers and sponsors involved with the Futures in Energy program. The program was very successful thanks to the help of 12 sponsors that provided $17,000 to cover all the costs for the students to attend and live on campus for the week.

For more information on how to contribute to the 2014 Futures in Energy program, contact me at mcarr@mines.edu or visit our website at www.pttcrockies.org.

We invite petroleum software companies to come in for a day or two and put on short courses for our chapter members. It's another enhancement to the education. This year we were able to get Golden Software and Schlumberger to explain how their software can be used to map and model petroleum reservoirs.

Futures in Energy students visit Dinosaur Ridge to discuss geology with Kermit Shields.

STUDENT NEWS

American Association of Petroleum Geologists

by Alex Gibson, Vice President

Weimer Trail Clean-up Day

Last year's chapter set the bar very high and to prove it, the Colorado School of Mines American Association of Petroleum Geologists (AAPG) Student Chapter won the Most Outstanding United States Student Chapter award at the AAPG Annual Convention Expo (ACE) in Pittsburgh, PA. This year was no exception. The chapter hosted a record of 12 Lunch–and-Learns, 5 socials, 2 field trips, 1 software short course and 1 petrophysical workshop.

Lunch–and-Learns were an important function for us this year. We consider these an important part of the education here in petroleum geology. Speakers came in from all over the country to present a one-hour talk to our student chapter. We even had 3 that were a part of the AAPG Distinguished Lecture series!

We invite petroleum software companies to come in for a day or two and put on short courses for our chapter members. It's another enhancement to the education. This year we were able to get Golden Software and Schlumberger to explain how their software can be used to map and model petroleum reservoirs.

Field trips are another important function that our chapter performs. Getting out on the rocks is fundamental to good interpretation and practice. This year we took funded field trips to see the Lewis Shale and San Salvador Island. Everyone enjoyed these great and educational experiences. Without the support of oil and gas companies, these trips would not be a reality.

Other AAPG Student Chapter events included the Bob Weimer Mines Geology Trail Clean-Up, member recruitment, bowling nights, group dinners and our inaugural Mustachio-Bashio. The chapter is more active than ever and members are looking forward to what can be accomplished throughout the remainder of the academic year in pursuit of Outstanding Student Chapter recognition at the AAPG Annual Convention and Exhibition in May. If alumni are interested in attending any events or would like to give a presentation to the student chapter, please don't hesitate to contact any of the current officers directly or through the chapter email (csmaapg@gmail.com).

Society of Economic Geologists

by Ty Connor, President

The Colorado School of Mines Society of Economic Geologists Student Chapter has a long history in the Department. Our chapter was the first SEG student chapter, established in 1987, and continues to be active today. We hold bi-monthly lunchtime lectures, field trips every semester, and new this year, we host monthly student "rock talks". We would like to take this opportunity to display what our chapter has accomplished in this past year, and hopefully encourage anyone interested in Economic Geology to join our chapter!

Our newly established student "rock talk" series has turned out to be a very exciting and important event for our chapter. Talks are held monthly, and they allow students to practice presentation skills in addition to getting a few extra eyes and ears on their research. For those in the audience, this

GRADUATING SENIOR AWARDS

For each commencement, faculty vote to give graduating students awards specific to the Department. Following are awardees for the 2012/2013 academic year.

May 2013

- Outstanding Graduating Senior - Weston LaFon
- The Brunton Award - Bradley Nuse and Erik Swanson
- The Hutchinson Award - Andrea Nolting and Alex Borchert
- The Neal J. Harr Memorial Pick - Courtney McGinn

December 2013

- The Brunton Award - Justin Wagner and Kimberly Reggish
- The Hutchinson Award - Andrew Joseph Graham

series allows for students to learn about the unique ore deposits being studied at CSM. As “he or she who sees the most rocks wins,” this series truly allows for our students to gain exposure throughout all facets of Economic Geology.

Along with our new “rock talk” series, we have continued our bi-monthly lunchtime guest lectures. We have invited guest experts on all types of ore deposits: i.e. sediment-hosted ore deposits, igneous and hydrothermal ore deposits, REE ore deposits, etc.; as well as guest experts in all types of Economic Geology industries: i.e. academia, the USGS, base metal exploration and production, precious metal exploration and production, industrial minerals companies, economics and policy, and even sub-sea floor mining! For example, Patrick Highsmith, previous CSM geology Masters student, gave a presentation entitled “The future of Mining: The Sustainable Society’s Supply Chain.” This presentation allowed our group to learn about the pressures and socio-economic issues that our industry will likely face in the future. Additionally, Dr. Dave Leach, formerly with USGS, presented

SEG Students listen to an overview of the geology at the Cripple Creek Mine, given by current CSM Masters student Matthew Dye

an overview of the relationship between evaporate minerals and certain sedimentary hosted ore deposits. This presentation helped our group to think outside of the box and to discuss new, leading ideas regarding ore deposit formation. The wide array of speakers and topics our guest speakers bring to our group are the backbone of student engagement and drives our group to think about issues outside of our individual research.

Some of the most beneficial opportunities our chapter has had this year were the opportunities to see rocks, mines, and active exploration in the field. This past year our group has had opportunities to visit the Cripple Creek gold mine and the Creede silver mine in Colorado, as well as many active mines and explor-ation sites in Columbia. This trip was led by Dr. Murray Hitzman and previous Masters student, now PhD student, Wesley Hall. Ten CSM-SEG students attended in January and returned with better understandings of the transition between porphyry and epithermal environments as well as an exciting once in a lifetime cultural experience.

Most recently, our chapter has had a unique opportunity to meet with one of the brightest minds in economic geology, Dr. Francois Robert, current Vice President of Exploration for Barrick Gold and newly elected Society of Economic Geology President. This particular

Dr. Murray Hitzman with SEG students Chris Olson, Erik Tharalson, Harry Hanneman, Justin Palmer, and Nicholas Kerr enjoy their time in Columbia with the SEG Student Chapter from the Universidad Nacional de Colombia Sede Medellin

SEG students outside of the Equity Silver Mine, Creede, CO

meet-and-greet along with others help students to engage with industry professionals and to learn about what it takes to be successful in our industry.

All of the activities our chapter is involved in, and the activities we have planned for the future, would not be possible without the help and guidance of our advisors and the Department of Geology and Geological Engineering. This includes, but is surely not limited to: faculty advisors Dr. Thomas Monecke, Dr. Murray Hitzman, Dr. Elizabeth Holley, and Dr. Graham Closs, our incredible support staff Debbie Cockburn, Marilyn Schwinger, Cheryl Medford, and Summer Jackson, everyone at the SEG headquarters, all of our student members who have engaged with and helped to plan activities, as well as our sponsors and guest speakers that volunteer their time to support this chapter. Our newly increased collaboration with DREGS along with other organizations such as AAPG, SME, and HSE should also be noted and thanked for our success. We hope you are able to attend some of our future activities and events, after all, he or she who sees the most rocks wins!

If you would like to contact the chapter, you may us at http://www.segweb.org/SEG/Students/Student_Chapters

MANY ASPECTS OF GEOLOGY

Photo Captions:

Top: Anxiously awaiting description of the sample by Justin Palmer

Middle: Field Camp 6th week teredolites

Bottom: Roadside geological engineering studying slope stability

Student Support

Our students are fortunate to be in a program that companies, alums, and friends of the Department believe in and support financially and with computer programs, equipment, and data. This support for students is critical to progress in their programs and the ability to afford the cost of their education. We gratefully acknowledge all sources of student support.

John Akinboyewa Bakken Consortium
Mohammad Al Duhailan Bakken Consortium
Matt Andresen Chevron Center of Research Excellence
Eric Anderson U. S. Geological Survey
Aaron Bazzell Bakken Consortium
Matt Belobraudic ADMC Consortium: Anadarko, Newfield, Schlumberger
Michael Berger Fogarty Fellowship, Bureau of Indian Affairs
Alex Betancur Vaca Muerta Consortium
James Bethune Department Teaching Assistant Funds
Steve Brennan Bakken Consortium
Peter Brice Endeavour Mining Corporation
David Broughton Amira P872, Ivanplats
Wes Buchanan Department Teaching Assistant Funds, NSF CAREER grant
Hayden Brown Department Teaching Assistant Funds
Patricia Capistrant First Quantum Minerals
Franki Carver Marathon, Nikki Hemmesch Fellowship
Robert Charnock Department Teaching Assistant Funds, NSF CAREER grant
Ty Conner NovaCopper
Lauren Cross Department Teaching Assistant Funds
Steve Crouch Niobrara Consortium

Celena Cui Department Teaching Assistant Funds, Florida Department of Health
Paige Cybulski Newmont Mining
Ian Donovan National Interagency Fire Center, Harold Hickey Fellowship
Casey Dowling Department Teaching Assistant Funds
Robert Duran Center for Underground Construction & Tunneling, Professional Development Funds
Henriette Eidsnes Bakken Consortium
Rana El Ghoniny Niobrara Consortium
Abdullah Eljalafi Professional Development Funds
Jae Erickson Department Teaching Assistant Funds
Ethan Faber Department Teaching Assistant Funds
Ellen Fehrs Bakken Consortium
Rachel Feist Department Teaching Assistant Funds
Dean Feller ADMC Consortium
Elena Finley Niobrara Consortium
Matt Fithian Goldcorp, Inc.
Alyssa Franklin Bakken Consortium
Ben Frieman Department Teaching Assistant Funds, Professional Development Funds
Allen Frierson RioMAR Consortium: BHP, BG, BP, Chevron, Devon, ENI, PDVSA, Petrobras, Shell, Statoil, Woodside
Joseph Gartner U. S. Geological Survey
Alex Gibson Eagleford
Tsolmon Gonchig Oyu Tolgoi LLC
Wes Hall Cupric Canyon Capitol, Discovery Metals
Charlie Harman Whiting Oil & Gas Company
Jouh Harper Niobrara Consortium
Ben Haugen Department Teaching Assistant Funds, NSF
Lindsay Hefton Niobrara Consortium
Andrew Heger Niobrara Consortium
Mike Hendrickson First Quantum Minerals, Fogarty Fellowship
Marta Hodan Department Teaching Assistant Funds, ADMC Consortium: Anadarko, Newfield
Carlos Hernandez Newmont Mining
Eider Hernandez-Bilbao Vaca Muerta Consortium
Lora Hoopes Undergraduate Research Fellowship, Professional Development Funds
Zane Houston Niobrara Consortium
Hui Jin Anadarko Petroleum, Bakken Consortium
Evan Jones ADMC Consortium: Anadarko, Newfield, BP (?)
Katy Kaproth-Gerecht NSF Fellowship
Amy Kenwell Department Teaching Assistant Funds
Nicholas Kernan Niobrara Consortium
Ted Kernan Vaca Muerta Consortium
Nick Kerr Teck Ireland
Louise Kiteley Isolated Sandbodies Consortium: Anadarko, Noble Energy
Katie Kocman Bakken Consortium
Talgat Kosset Vaca Muerta Consortium
Jack Krantz Professional Development Funds
Kritti Kreeprasertkul Bakken Consortium
Mason Kreidler Center for Underground Construction and Tunneling
Basak Kurtogly Bakken Consortium
Fabien Laugier RioMAR Consortium: BHP, BG, BP, Chevron, Devon, ENI, PDVSA, Petrobras,Shell, Statoil, Woodside, BP
Russell Lewis Niobrara Consortium
Gary Listiano Bakken Consortium
Ben Lowry UNAVCO/CGG
Ryan Marsters Colorado Geological Survey

Nick Matthies Niobrara Consortium
Mack McLain AEG Tilford Scholarship
Kevin McCoy National Interagency Fire Center
Bryan McDowell REPSEA
Corey Meighan Fogarty Fellowship, First Quantum Minerals
Matt Minnick RESPEC
Nathan Mollica Center for Underground Construction & Tunneling, Professional Development Funds
Jeremiah Moody Chevron Center of Research Excellence
Ryan Mulhall Department Teaching Assistant Funds
Devon Murray Niobrara Consortium
Kazumi Nakamura Whiting Oil and Gas Co., Niobrara Consortium
Dipanwita Nandy Bakken Consortium
Jackie Negri Federal Highways Administration
Bradley Nuse Chevron Center of Research Excellence
Kimber O'Brien Chevron Center of Research Excellence
Denton O'Neal Niobrara Consortium
Kenya Ono INPEX Corporation
Anton Deben Padin Vaca Muerta Consortium, Eagleford
Justin Palmer ATAC Resources Ltd.
Jesse Pisel Chevron Center of Research Excellence
Julie Pokorny NSF CAREER grant
Chris Pederson John & Carolyn Mann Fellowship
Rodrigo Prugue DOE
Moira Pryhoda NSF
Patrick Quigley Department Teaching Assistant Funds
Jennie Rietman Niobrara Consortium
Mandi Reinshagen Rare Element Resources
Tony Rios Bakken Consortium
Amanda Rock Department Teaching Assistant Funds
Colgan Smith U. S. Geological Survey
Cosima Theloy Bakken Consortium
Helen Thomas Department Teaching Assistant Funds
Jane Stammer Chevron Center of Research Excellence
Ryan Swanson NSF Fellowship
Michael Sweetenham Center for Underground Construction and Tunneling
Emily Voytek Poate Fellowship
Jianqiao Wang Department Teaching Assistant Funds, ADMC Consortium: Anadarko, Newfield
Austin Wilkes Center for Underground Construction & Tunneling, Professional Development Funds
Max Willis Vaca Muerta Consortium
Travis Wokash Department Teaching Assistant Funds
Jon Woodhead Freeport McMoRan
Kristi Zellmann BP, ADMC Consortium: Anadarko, Newfield

Bahamas Field Course – AAPG Student Chapter, December 2013

By John Humphrey and Steve Brennan

The CSM AAPG student chapter sent a delegation to the Bahamas in mid-December to participate in a 6-day field course in this classic modern carbonate environment. Carbonate systems are important to the petroleum industry because they account for more than 60% of the world's oil reserves and 40% of gas reserves (Schlumberger Market Analysis, 2007). CSM faculty think it's critical that their students have a solid understanding of these systems in order to properly recognize targets and to develop technologies for enhanced recovery.

The 6-day study took place on the Bahamian island of San Salvador. The island is one of the outermost of a chain of some 700 Bahamian islands sprinkled throughout more than 5,000 square miles of the most beautiful waters of the world. Although the island is similar to the others of this archipelago, it is unique for its history, ecology, inland lakes, and potential for future development. Most notably, in 1492 Christopher Columbus made his first landfall in the New World on San Salvador. The student chapter organized all flights and lodging for this trip.

A group of 20 students was led by professors Dr. John Humphrey and Dr. Piret Plink-Björklund. Dr. Humphrey specializes in carbonate sedimentology, diagenesis and geochemistry, while Dr. Plink- Björklund is a stratigrapher. Throughout the trip, they complemented each other and provided an interesting dynamic to the course. Both professors are renowned for contributing their time to student field research, and the CSM AAPG student chapter was fortunate to have them lead the Bahamas' field course.

During this trip, students were constantly challenged to better understand the development and evolution of carbonate systems within a regional depositional framework. The heterogeneity of environments within a carbonate system must be understood to properly recognize facies distributions. Also, by studying facies distributions and carbonate evolution within the region, students gained valuable knowledge and insights that will be important for reservoir modeling. Discussions of early carbonate diagenesis were interspersed throughout the trip – we observed beach rock, meteoric leaching and karst and cave development, early marine cementation, and caliche formation.

While on the San Salvador, the group was housed at the Gerace Research Center (GRC). The GRC is part of the College of the Bahamas and has a continuing agreement with the Bahamian government to undertake a wide range of environmental research projects in the natural and social sciences and humanities. San Salvador and the GRC provided comfortable yet relatively spartan lodging, and the food was plentiful. The weather was fantastic and the Trade Winds were calm. The down side to beautiful weather was an overabundance of mosquitoes and sand fleas. Sometimes, there's a price for paradise.

Aboard our trusty field vehicle

IN PARADISE

Photo Captions:

Top: Student and faculty participants of the Bahamas field course

Middle: Dr. Humphrey discussing carbonate facies distributions

Bottom: A superbly preserved Pleistocene brain coral (Diploria strigosa)

North Point vista showing Pleistocene limestone and Holocene carbonate eolian dunes.

A typical field day on San Salvador consisted of upwards of four hours snorkeling in the sea to observe the modern carbonate factory at work. Reefs and patch reefs were easily accessible and the waters were relatively calm for this time of year. In order to assist in the preparation of fellow students, three chapter members led snorkeling and swimming lessons on Mines' campus before departure. Teachers included students Steve Brennan, Dayna Jacob, and Spencer Rolfs. Dr. Humphrey encouraged the effort in order to ensure the safety and confidence of all students in the class.

This entire trip was made possible by generous donations from Chevron and BP. The student chapter graciously thanks them for their support. The field skills developed during this trip and the general knowledge gained from this fieldwork will be useful in a wide range of depositional systems, and the students will undoubtedly reflect upon these 6 days for the rest of their lives.

FIELD CAMP 2013

By Leigh Horton and Brianna Svoboda

Admittedly, geologists and geological engineers have some of the best views from their office windows. The climb to reach that window is not without its challenges. The work is dirty, but worth the effort. This fact is never clearer than sitting on top of the Mancos Shale in Moab, Utah, trying to map geologic units and faults, while avoiding the critical gaze of our professors. Field camp, while nurturing a slight invincibility complex when complete, is full of mystery for the uninitiated. Prior to camp, the horror stories haunting Berthoud Hall's students in the fall are rife with rattlesnakes, swamps, and enchanted forests filled with unicorns. And work. Lots of hard work.

The Class of 2014 endured their field immersion and succeeded in climbing to the top in style. With frequent trips to McDonalds and Wendy's (desperation at its finest), once-a-week showers (totaling a small fortune), mac and cheese with peanut butter (don't try that at home, kids), and mildewed tents (that were impossible to construct), we all bonded. Through the assignments, we gained an appreciation for each other and the profession we have chosen. Eager to relive some of the highlights and bemoan the lowlights, the Class of 2014 would like to share our memories and offer field camp lessons not taken for granite.

Week 1: Moab, UT

Once covered by salty seas, Moab presented a tectonically unique and striking experience. Salt domes and faults challenged and advanced our mapping skills, while sheer rock faces tested our sanity and balance. From the Delicate Arch in Arches National Park to the relay ramps covering Mill Canyon, the scenery could not have been better.

Our Leaders: Dr. Mary Carr, Thomas Hearon, Jess Matthews, Claire Pless, and Patrick Geesaman

Week at a glance: About fifteen jam-packed cars rolled into the Lazy Lizard Hostel by 5pm on Sunday evening. Getting to know our classmates better than we had ever thought possible, we began our field camp trials and tribulations. Three days were spent in the Delicate Arch mapping area and two days in the Mill Canyon mapping area. We met at 6:30AM to depart to the field every day and returned by 4:30PM. Dr. Mary Carr greeted us upon return with refreshing and chilled juice boxes. Who knew juice boxes could be such a treat?! After emerging from the field, everyone grabbed a quick dinner and then worked late hours into the night before exhaustion took over and eyelids fell shut.

Lessons not taken for granite:

•The importance of covering ground in a timely fashion

•Hydrate!

•Learning to map while standing up (leaving the backpacks on)

OUTDOOR LAB

Photo Captions:

Top: Salt Valley, Moab, UT

Middle: The Difficult Climb, Moab, UT

Bottom: Mapping at McDonalds

•Refining compass techniques (the Class of 2014 had a particular fondness for dip and dip direction—Thank you Dr. Yvette Kuiper!)

Memorable Moments:

• "Difficult Jump" (labeled on our mapping areas)…for many of us, the difficult jump turned into a challenging climb since our only other option was to retrace our steps, which would have taken us miles out of the way. For once, groups greater than two were acceptable. Kim Reggish- we are proud of you!

• "When in doubt, fault it out." In retrospect, this maybe was not the best philosophy, but Moab certainly had no shortage of faults!

•McDonald's or Wendy's anyone? In times of great need, it's amazing what a table, air conditioning, and a Frosty can do to improve one's mood while frantically coloring maps and making final interpretations from much loved field notebooks.

•"When you are thrashing through the willows looking for the fault, your gonna wish you were back in Moab!"—Words of advice from Patrick

•Measuring stratigraphic sections to become the best Jacob Staffers to date!

Week Two: Durango, CO

The thriving mountain town of Durango, built on glacial moraines, served as our stomping grounds for the second week of field camp. With a drastic change of scenery, an urban setting and cushy dorm life at Ft. Lewis College is where we spent the week's duration learning to map surficial geology of glacial moraines and outwashes.

Our Leaders: Dr. Jerry Higgins, Dr. Paul Santi, Dr. Wendy Zhou, Bret Arpin, and Amanda Rock

Week at a glance: The change to an urban setting was not without its advantages. We met at the vans at 7:45AM to be dropped off at our desired field location for the day and were picked up along the roadside around 4:30PM. The goal of the week was "precision mapping." We were treated mid-week with a BBQ and a surprise visit from our recently graduated TA, Casey Dowling.

Thursday was the geo-hazards field trip day where we observed rock fall hazard areas, landslides, and debris flows. We also had the pleasure of meeting John Ey and his overjoyed puppy during our visit to Lemon Dam. John spoke about the innovative measures taken to preserve and protect the dam after a wildfire destroyed the surrounding area. Debris racks, retention ponds, log erosion barriers, seeding, mulching, and crimping were just a few of the measures taken to rehabilitate and protect the area.

Debris rack at Lemon Dam

Lessons not taken for granite:

•Mapping with precision is different from mapping large areas like Moab

•Urban mapping means private property, which often restricts access to areas of interest

•Stereo pairs are useful tools to take advantage of before entering the field

•Orange vests are stylish

Memorable Moments:

•Cookie Moraines

•Mother nature claimed a few rock hammers this week

•Watch out for cars!

•Never doubt the effect a dog can have on morale

Week 3: Salida, CO

Up. Down. Up and down. Wait, didn't we just climb that mountain? This was the week of extreme topography and breath-taking views of the Rocky Mountains. It was also our introduction to camp life. From work tents to once-a-week showers (if you made the trek down the mountain to the local recreation center), Salida was a new experience.

Aspirations of Greatness!

Our Leaders: Dr. Paul Santi, Dr. Alexis Navarre-Sitchler, Dr. Ric Wendlant, Amanda Rock, and Andrea Nolting

Week at a glance: After getting a bit lost on the way to the campground on Sunday evening, we began the new weekly tradition of setting up base camp. Our days in the field began at 7:30AM and finished around 4:30PM. After a seriously good mountain climbing workout, we went to work in the work tents. Generators brought us the luxury of electricity (and heat) until 10PM when they were promptly turned off. Headlamps often came on at this point to continue working.

The primary objectives this week were to map complex geology that had a mix of sedimentary, metamorphic, and intrusive igneous rocks. The geology was used for resource assessment and recommendations for power line locations. Rock mechanics came in handy this week, as well as a good pair of boots and strong legs.

Lessons not taken for granite:

•Follow the Parting

•Mapping float rock can be beneficial when in-place rock is nowhere to be found. It can also be confusing.

•Do not get lost in the Ki

•Cross sections are key in helping to visualize what might be happening in an utterly confusing area

A beautiful day for mapping gravel deposits just outside the town of Durango

Memorable Moments:

•"Reunited with the Parting!"

•Paul's gourmet hot-dogs

•Our morning wake up call from the cows! A heard of free-range cattle decided they wanted to walk right through our camp. Paul and others were out in the early morning hours encouraging the cattle to take a different route rather than straight through our camp. Paul ended up herding them right THROUGH the upper part of camp though. Brings a new meaning to cattle call!

•Calumet Mountain- Rock hounding at its finest with world class epidote samples.

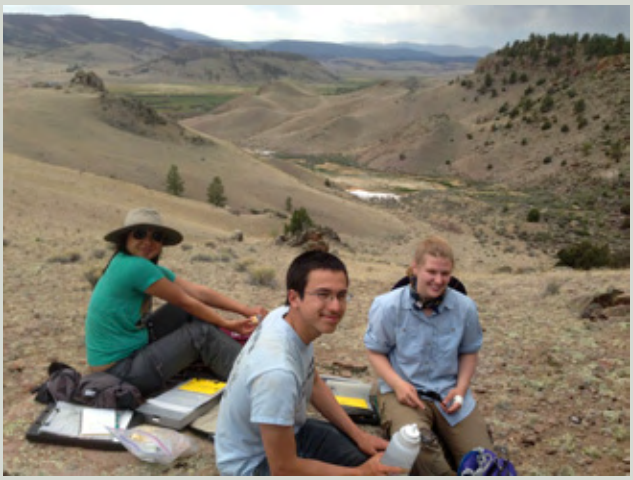
•"Deal with it!"

•"No clumping!"

•The beginning of "Friday rains." The rain came just in time for us to pack up the work tents and little did we know that this would become a trend for the rest of field camp.

Left: How many engineers does it take to build a tent?

Right: The vastness of the Saguache mapping area



Week 4: Saguache, CO

The most remote site of field camp, Saguache lived up to its reputation of being one of the most challenging weeks for all. With twelve square miles to cover, we discovered that volcanic deposits did not follow any rules or stratigraphic order.

Our Leaders: Dr. Ric Wendlandt, Dr. Nigel Kelly, Dr. Yvette Kuiper, Amanda Rock, and Andrea Nolting.

Week at a glance: Days once again began around 7:30AM and ended around 4:30PM in the field. The quiet van rides to and from either the north or south side of the divided mapping area were respites from the wind and dust that often joined us this week.

Mappers in the north battled streams, cliff edges, and new geology that had not been introduced on day one to the group. Mappers in the south took on Mountain 9519 and reached the summit, occasionally feeling the toll that the thin mountain air can take on the lungs. Rattlesnakes were a daily adventure to avoid, particularly in the overlapping field areas. Composite mapping partners met up on Thursday to verify and concur on the overlap area of the north and south.

Nigel and Ric both examining samples. Science in progress; stay clear.

Lessons not taken for granite:

•The Conejos Formation has LOTS of variability

•The Fish Canyon Tuff has a characteristic “plunk” sound when hit with a rock hammer

•Faults were easier to see in Moab…

Memorable Moments:

•“Trails” of petrified wood

•Campfires, smores, and macaroni and cheese

•Battles with cacti…watch where you put your hands for support!

•A bear, oh my! Our TA’s came across a bear in the field area, which got the heart racing to say the least.

•Rattlesnakes…need we say more.

•Tuffs on tuffs on tuffs

•Kate fell into “poop creek”—twice

•The “Friday rains” returned just in time for the work tents to be packed

Week 5: Molas Pass, near Silverton, CO

In the last week of camping, the highest elevation mapping location, and the most brilliant of sceneries, Molas Pass awaited. Those who have experienced field camp at CSM know, the motto for the week was “this is how we do it fifth week!”

Our Leaders: Dr. John Humphrey, Dr. Steve Sonnenberg, Dr. Donna Anderson, Andrea Nolting, and Lindsay Hefton

Week at a glance: The tents and work tents were pitched for the last time on Sunday evening. Mapping days began at 7:30AM in the field and ended around 4:30PM.

Molas Lake was a world of carbonate geology. Disappearing streams, sink holes (both ancient and modern), and karst towers provided a new and unique mapping challenge.

Lessons not taken for granite:

•Always keep an eye out for green flags (which blend right into the trees) or you’re bound to miss something important!

•Appreciate the convenience of stepping outside your tent and being in the mapping area

•Do not get lost in the Enchanted Forest

•Structural data is essential at the waterfall

Memorable Moments:

•We went "thrashing through the willows" and we found Snowdon Fault (the snow was melted for the first time in about 15 years!)

•Eureka Flats, the Swamp, and the Enchanted Forest (It was like living in a fairy tale)

•Purple Quartzite!

•The Avalanche Café in nearby Silverton had great pizza and was a nice reprieve from the moldy aromas of the work tents.

•Crinoid stems make great souvenirs as does the memory of the "fossil dance"

•Excellent place for trundling!

•Cooling off with a swim in Molas Lake or a brisk shower under the waterfall

•The campfire and steak and fish dinner on Wednesday night!

Week 6: The Great Divide

The final week of field camp was marked by the separation of the group into one of three areas:

Geotechnical mapping in Silverton, CO

Underground mine mapping in Idaho Springs, CO

Exploration of petroleum systems in Green River, WY

The Highlights:

Silverton, CO

Attention to detail and variation between talus slopes, debris flows/fans, and avalanche chutes

Learning the challenges of road mapping due to private property

"Sneaky" engineers crossing on the fringes of private property (crouched down with bright orange vests on!)

Study time at the local library with our own private room and supply of fresh baked cookies

FIELD CAMP - EVERYBODY'S FAVORITE!

Photo Captions:

Top: The Disappearing Stream

Middle: Using our Jacob Staff skills from Moab

Bottom: Debris flow on top of debris flow? Or vice versa?

Idaho Springs, CO

The crew went underground to map vein structures in Edgar Mine

A visit to Cripple Creek Mine - exploring the operations of an open pit mine and watching a blast in action

Cooling off inside the tunnel

The challenges of being too tall

Green River, WY

Exploration of marine depositional environments and hydrocarbon potentials

Visit to a drill rig

Anadarko treated us to a steak dinner at the local brewery

Finding a coquina layer made of nothing but oyster shells!

Cripple Creek Mine Blast

With the conclusion of week 6, the Class of 2014 survived field camp and the luxuries of hot water, warm food, soft beds, and a washing machine welcomed us all home. As graduation now approaches, we remember the friendships made and memories that will never be forgotten as we make our way to the office with the best views. We would like to thank all those that helped to make field camp possible and leave you with some of our unforgettable field camp friends:

Above: The Wyoming Group
Right: The Drill Rig

Left: The Lizard: Moab

Right: The horny toad: Durango

Below left: The rattlesnake: Moab and Saguache

Below middle: The dog with goggles: Silverton

Below right: The llamas: Silverton

It was 20 years ago today

1. Kendall Hovel
2. Brad Woodard
3. Jay Davenport
4. Pam Kimmel
5. Kevin Creel
6. Brett Byler
7. Harold Hutson
8. Mike Berry
9. Michael Craig (CU)
10. Kerry Aggen
11. Keith Woodburne
12. Amy Johnson
13. Barry Gaston
14. James Barron

not shown: Moose Hofer

Where are they now?

THESES COMPLETED 2013

Theses Completed May 2013

ALKUWAIRAN, MARYAM – PH.D. – GEOLOGY
Polygenetic dolomite in mixed carbonate-siliciclastic environment: A mineralogical study of co-occurring dolomite types in sub-tidal sediments of northern Kuwait Bay, Kuwait (Adv. Dr. Humphrey)

ARTHUR, THOMAS – M.SC. – GEOLOGY
Petroleum Geology of the Basal Niobrara Sandstone, West Puerto Chiquito Field, Rio Arriba County, New Mexico (Adv. Dr. Sonnenberg)

BARBER, JOEL – M.SC. – HYDROLOGY
Investigating the Use of Ecozones in the Design of Water Balance Covers for Waste Containments by Analyzing the Sensitivity of Cover Effectiveness to Climate, Vegetation, and Soil Parameter (Adv. Dr. Benson)

BRUCHEZ, KELLY – M.SC. – GEOLOGY
Regional Outcrop Correlation of the Niobrara Formation, Northwestern Colorado (Adv. Dr. Sonnenberg)

DOWLING, CASEY – M.SC. – GEOLOGY
An Analysis of Debris Flow Fatalities and Related Socioeconomic Factors from 1950-2011 (Adv. Dr. Santi)
EDELEN, JEFFREY – M.SC. – GEOLOGY
The Geology of the Cerro Jumil Gold Skarn Deposit (Adv. Dr. Monecke)
FRIERSON, ALLEN – M.SC – GEOLOGY
Seismic-to-Core Linkage: Insight into Shelf-Margin Dynamics in the National Petroleum Reserve, Alaska (Adv. Dr. Plink-Bjorklund)
GORDON, GREGORY – PH.D. – GEOLOGY
Stratigraphic Evolution and Architectural Analysis of Structurally Confined Submarine Fans (Adv. Dr. Pyles)
HARVEY, KOREY – M.SC. – GEOLOGY
Analysis and Correlation of Growth Strata of the Lower Dawson Formation: insight into the Tectono-stratigraphic Evolution of the Colorado Front Range (Adv. Dr. Aschoff)
IBRAHIM, HAMED – M.SC. – HYDROLOGY
Comparison of Fickian and Temporally Non-local Transport Theories using High Resolution Hydraulic Conductivity from the Macrodispersion Experiment (MADE) Site (Adv. Dr. Benson)
KIRSCH, KATHERINE – M.SC. – HYDROLOGY
CO_2-Induced Metal Release from Sandstone: Implications for Geologic Carbon Sequestration (Adv. Dr. Sitchler)
KRUEGER, MARTIN C. – M.SC. – GEOLOGY
Stratigraphy, Log Character, and Petroleum Potential of the Cretaceous Niobrara Formation and Underlying Lower Mancos Group, Piceance Basin, Northwest, CO, USA (Adv. Dr. Sonnenberg)
LEE, EDWARD C. – M.SC. – GEOLOGY
Natural Fracture Analysis Related to Facies and Strain Variability in the Middle and Upper Williams Fork Formation, Piceance Basin, Colorado (Adv. Dr. Trudgill)
MEYERHOFF, STEVEN – PH.D. – HYDROLOGY
Understanding Heterogeneity and Data Assimilation in the Karst Groundwater Surface Water Interaction: The Role of Geophysics and Hydrologic Models in a Semi-Confined Aquifer (Adv. Dr. Maxwell)
NICHOLLS, OWEN G. – M.SC. – GEOLOGY
Mineralization Related to the Biotite Syenite Dike Complex at the Money Knob Gold Deposit, Livengood, Alaska (Adv. Dr. Monecke)
SCHIENTINGER, PAUL – M.SC. – GEOLOGY
Upper Devonian-Lower Mississippian Stratigraphy of Northwestern Montana: A Petroleum System Approach (Adv. Dr. Sonnenberg)
SENDZIAK, KASSANDRA – M.SC. – GEOLOGY
Architectural Analysis and Hierarchical Framework of Floodplain Strata in a Low Net-Sand Content Fluvial Succession, Lower Wasatch Formation, Uinta Basin, Utah (Adv. Dr. Pyles)
SIIRILA, ERICA R. – PH.D. – HYDROLOGY
On the Interplay Between Scaling Small-scale Reactions, Mixing, and Aquifer Heterogeneity: Human Health Risk Implications (Adv. Dr. Maxwell)
STOCKHAUSEN, TIMOTHY – M.SC. – GEOLOGY
The Upper Conglomerate and its Importance to the Sierra Mojada Ag-Zn Deposit System, Coahuila, Mexico (Adv. Dr. Hitzman)
STUMB, MORGAN – M.SC. – HYDROLOGY
Examination of Solute Transport in Highly Heterogeneous Media at the Macrodispersion Experiment (MADE) Site (Adv. Benson)
THARALSON, ERIK – M.SC. – GEOLOGY
Understanding the role of footwall sulfur, ore mineralogy, and igneous stratigraphy on the formation of the Serpentine Cu-Ni Deposit, Duluth Complex, Northeastern Minnesota (Adv. Dr. Monecke)
UNDERWOOD, DAVID – M.SC. – GEOLOGY
Polygonal Fault Systems: A New Structural Style for the Niobrara and Lower Pierre Shale, Denver Basin Colorado (Adv. Dr. Sonnenberg)
WIECHMAN, MICHELE – M.SC. – GEOLOGY
Basin-Scale Sequence Stratigraphy and Distribution of Depositional and Mechanical Units in the Middle and Upper Williams Fork Formation, Piceance Basin, Colorado (Adv. Dr. Aschoff)

Theses Completed December 2013

AL QAHTANI, ABDULLAH – M.SC. – GEOLOGY
Sedimentology and Sequence Stratigraphy of the Muddy (J) Sandstone in the Golden/Morrison Area, Jefferson County and Peoria Field, Arapahoe County, Colorado (Adv. Dr. Plink-Bjorklund)
ANDERSON, ERIC – PH.D. – GEOLOGY
Aeromagnetic Signature of the Geology and Mineral Resources Near the Pebble Porphyry Cu-Au-Mo Deposit, Southwest Alaska (Adv. Dr. Zhou)
ARPIN, BRETT DANIEL – M.SC. – GEOLOGY
Development of Standardized Testing Procedures for Flexible Rockfall Fence Systems (Adv. Dr. Higgins)
BROUGHTON, DAVID W. – PH.D. – GEOLOGY
Geology and Ore Deposits of the Central African Copperbelt (Adv. Dr. Hitzman)
CAPISTRANT, PATRICIA – M.SC. – GEOLOGY
Geology of the Enterprise Hydrothermal Nickel Deposit, Eastern Kabompo Dome, North-Western Province, Zambia (Adv. Dr. Hitzman)
HALL, WESLEY S. – M.SC. – GEOLOGY
Geology and Paragenesis of the Boseto Copper Deposits, Kalahari Copperbelt, Northwest Botswana (Adv. Dr. Hitzman)
HEARON, THOMAS – PH.D. – GEOLOGY
Analysis of Salt-Sediment Interaction Associated with Steep Diapirs and Allochthonous Salt: Flinders and Eastern Willouran Ranges, South Australia, and the Deepwater Northern Gulf of Mexico (Adv. Dr. Trudgill)

HENDRICKSON, MICHAEL – M.SC. – GEOLOGY
Geology of the Fishtie Copper Deposit, Central Province, Zambia (Adv. Dr. Hitzman)
KAYKUN, ARMAGAN – M.SC. – GEOLOGY
Sequence Stratigraphy of the Lower Pierre Shale, in Southern Powder River Basin, Wyoming (Adv. Dr. Sonnenberg)
KERR, NICHOLAS – M.SC. – GEOLOGY
Geology of the Stonepark Zn-Pb Prospect (Adv. Dr. Hitzman)
LEIBOLD, JULIE – PH.D. – GEOLOGY
Geochemistry and Mineralogy of the Alteration Halo Associated with the Three Crow Roll-front Uranium Deposit, Nebraska (Adv. Drs. Monecke/Wendlandt)
LEWIS, RUSSELL, T. – M.SC. – GEOLOGY
Stratigraphy and Depositional Environments of the Late Cretaceous (Late Turonian) Codell Sandstone and Juana Lopez Members of the Carlile Shale, Southeast Colorado (Adv. Dr. Sonnenberg)
LIN, VIVIAN – M.SC. – GEOLOGY
Integrated Seismic and Geologic Analysis of Waddle Creek Field in Southwestern Moffat County, Colorado (Adv. Dr. Sarg)
MARSTERS, RYAN – M.SC. – GEOLOGY
A GIS Process for Assessing Abandoned Coal Mine Subsidence, Boulder-Weld Counties, Colorado (Adv. Dr. Higgins)
MATTHEWS, JESSICA – PH.D. – GEOLOGY
The Impact of Accessory Minerals on the Distribution of Trace Elements in the Continental Crust: An Integrated Petrologic and Thermodynamic Modeling Study of Migmatites (Adv. Dr. Kelly)
O'HARA, TIMOTHY R. – M.SC. – GEOLOGY
Depositional Setting and Reservoir-Scale Architecture of Sandstone Bodies of the Green River Formation in Evacuation Creek, Dragon Quadrangle, Eastern Uinta Basin, Utah (Adv. Dr. Sarg)
PEREZ-GUTIERREZ, CARLOS M. – MS.C. – GEOLOGY
Structural Kinematics and Salt Evolution in the "Kuzam" Area: Offshore Southeast Gulf of Mexico: Implications for Petroleum Prospectivity (Adv. Dr. Trudgill)
RAHFELD, ANNE – M.SC. – GEOLOGY
Mineralogical and Geochemical Fingerprints of Alteration Associated with the Cripple Creek Alkaline-Magnatic Au-Te Deposit, Colorado (Adv. Dr. Monecke)
WOODHEAD, JON – PH.D. – GEOLOGY
Sequence Stratigraphy, Alteration, and Mineralization in the Neoproterozoic Roan Group Zambian Copperbelt (Adv. Dr. Hitzman)

Robert J. Weimer Distinguished Chair in Sedimentary and Petroleum Geology

Led by a dedicated group of geology faculty and alumni, nearly $2.5 million was raised to establish the Robert J. Weimer Distinguished Endowed Chair in Sedimentary and Petroleum Geology. The endowed chair celebrates the legacy of Professor Emeritus Bob Weimer, and will enable the university to recognize and reward a highly accomplished senior scholar to teach and conduct research within its Department of Geology and Geological Engineering. The search will begin in 2014 to identify an individual that will complement the Department's reputation for innovative teaching and cutting-edge research. The successful candidate is expected to conduct a vigorous, externally-funded research program that includes collaboration with researchers in the petroleum industry, direct graduate student research, and teach graduate courses in his/her specialty. The candidate will provide leadership in multidisciplinary integration of petroleum geoscience across campus, and especially within the College of Earth Resource Sciences and Engineering that includes the departments of Geophysics, Mining Engineering, and Petroleum Engineering. The Chair is expected to be filled in August 2014.

John Robinson, Bob Weimer, and John Warme

HELLO

New and continuing students

When we went into the lecture hall for the business part of the Meet & Greet, the day was beautiful. We came out to catered barbecue and cloudy skies. We started our picnic and the rain and lightening followed soon after. Into Berthoud Hall we went to continue our event. Rain can't dampen our spirits!

Weimer Chair Announcement Reception

Greg Dykes, Alyssa Franklin and Fabien Laugier

Dean Graves, Department Head Santi

The Parflowvians* Research Brainstorming Session

Let's see, I think this was Bohr's pose at the Salvay Conference.

Is there any way I can use that upside-down triangle thing in my research?

I wonder if there is anyone with 4 Mines degrees?

Escape... escape... escape. How can I get out of here?

Why didn't I take that other post-doc?

You know, I really like vanilla.

Are there any more Apple products out there I could buy?

Oops! Wrong finger.

OK. First I kill Reed, then take over the group, then change the programs to Wolf-flow, then...

If I push hard enough, will my cheeks bulge?

* Reed Maxwell's research group named for the Parflow Family of modeling programs

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Geology is important to many areas important to humanity, from hazards to water resources to changing climate. We are training outstanding students to be stewards of our earth's natural resources.

A great day with Irish rocks

Apologies

Due to many circumstances, this publication of the *Newsletter* is very late. Many of the events listed as "upcoming" have occurred. However, we are publishing it as though the date would have been early in 2014.